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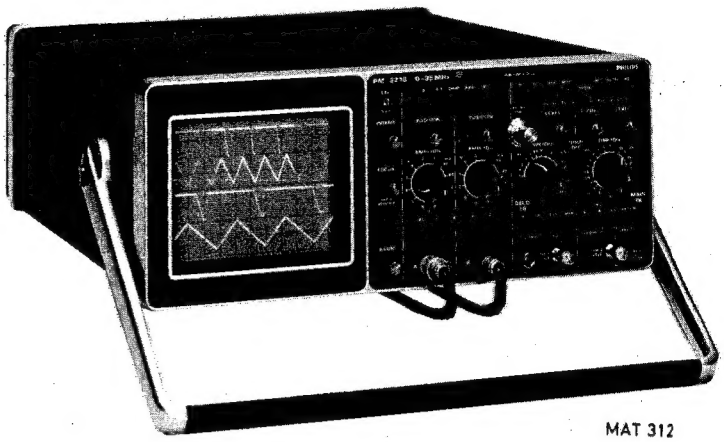

MAT 312

Instruction manual

Gerätehandbuch

Mode d'emploi

35 MHz Dual channel oscilloscope
35 MHz Zweikanal-Oszilloskop
Oscilloscope 35 MHz à double trace

PM 3218

9444 032 18..1

9499 443 00102

19O625

IMPORTANT

In correspondence concerning this instrument, please quote the type number and serial number as given on the type plate.

WICHTIG

Bei Schriftwechsel über dieses Gerät wird gebeten, die genaue Typenbezeichnung und die Gerätenummer anzugeben. Diese befinden sich auf dem Leistungsschild.

IMPORTANT

RECHANGE DES PIECES DETACHEES (Réparations)

Dans votre correspondance et dans vos réclamations se rapportant à cet appareil, veuillez TOUJOURS indiquer le numéro de type et le numéro de série qui sont marqués sur la plaquette de caractéristiques.

Note: *The design of this instrument is subject to continuous development and improvement. Consequently, this instrument may incorporate minor changes in detail from the information contained in this manual.*

Bemerkung: *Die Konstruktion und Schaltung dieses Geräts wird ständig weiterentwickelt und verbessert. Deswegen kann dieses Gerät von den in dieser Anleitung stehenden Angaben abweichen.*

Remarques: *Cet appareil est l'objet de développements et améliorations continuels. En conséquence, certains détails mineurs peuvent différer des informations données dans la présente notice d'emploi et d'entretien.*

PRINTED IN THE NETHERLANDS

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1. General information

1.1 INTRODUCTION

The 35 MHz dual-channel oscilloscope PM 3218 is a compact, portable instrument, ergonomically designed to facilitate its extensive measuring capabilities.

The instrument provides both a main and a delayed timebase with provision for alternate timebase displays, comprehensive triggering facilities including peak-to-peak Auto, DC coupling and automatic TV waveform display.

A large 8 x 10 cm screen with illuminated internal graticule lines makes for easier viewing, and a 10 kV accelerating potential gives a high intensity trace with a well-defined spot.

A double-insulated power supply allows the frame ground to be directly connected to floating ground circuits provided that this ground does not carry live potentials. By this means, interference by ground currents, as is frequently experienced with grounded oscilloscopes, is also substantially reduced.

The wide range of applications enabled by the above features is further extended by a versatile power supply that enables the instrument to be operated from different line voltages as well as from d.c. For field operation an optional battery version is also available.

Warning: The frame ground (and the ground lead of the probe) must not be connected to live potentials.

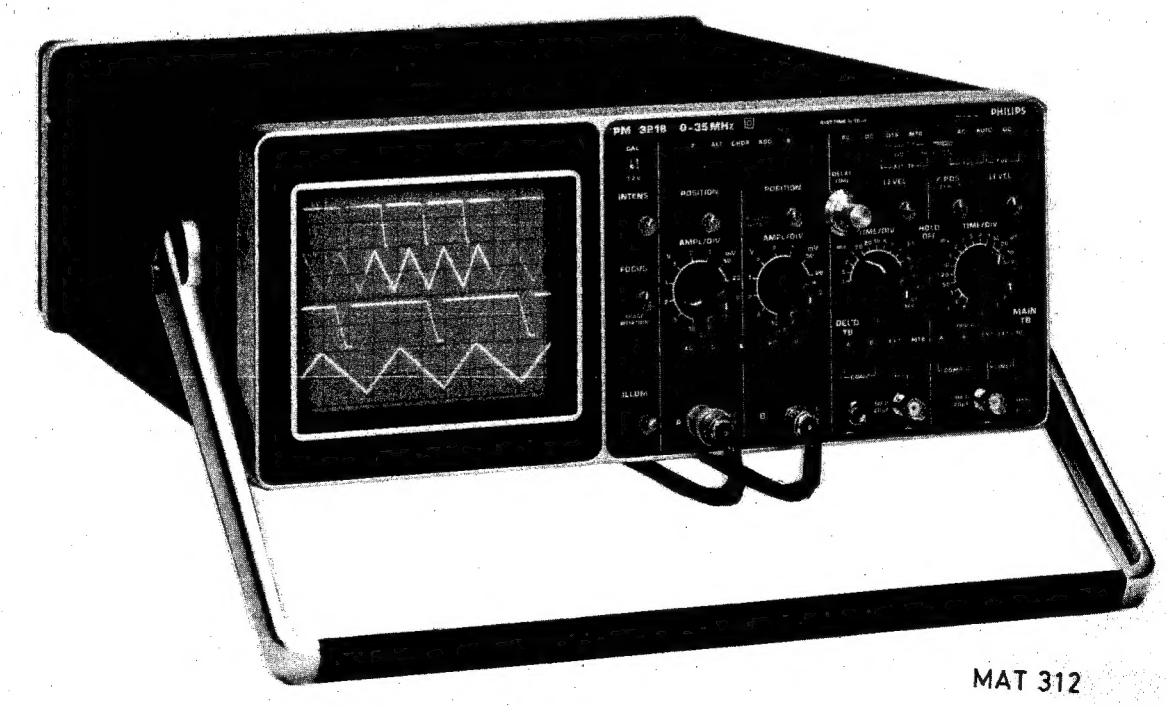


Fig. 1.1. 35 MHz dual-channel oscilloscope PM3218

1.2. CHARACTERISTICS

This instrument has been designed and tested according to IEC Publication 348 for Class II instruments and has been supplied in a safe condition. The present Instruction Manual contains information and warnings which shall be followed by the purchaser to ensure safe operation and to retain the instrument in a safe condition. Properties expressed in numerical values with stated tolerances are guaranteed for ambient temperatures of +5 °C ... +40 °C unless stated otherwise. Numerical values without tolerances are typical and represent the characteristics of an average instrument. The data apply after a warming-up period of 30 minutes.

	Designation	*Specification*	*Additional Information*
1.2.1	**C.R.T.**		
	Type	D14-125 GH/08	Rectangular tube face, mesh type, post accelerator, metal backed phosphor.
	Measuring area	8 x 10 divisions	1 div. equals 1 cm
	Screen type	P31 (GH)	P7 (GM) optional
	Total acceleration	10 kV	
	Graticule	Internal	Cont. variable illumination
	Engravings	Centimetre divisions with subdivisions of 2 mm along the central axes. Dotted lines indicate 10% and 90% of measuring lattice for measurement of rise time.	
1.2.2	**Vertical or Y-axis**		
	Display modes	Channel A only Channel B only A and B chopped A and B alternating A and B added	
	Channel B polarity	Normal or inverted	
	Response:		
	Frequency range	DC : 0 .... 35 MHz (-3dB) AC : 2 Hz .... 35 MHz (-3dB)	
	Rise time	$\leqslant$ 10ns	
	Pulse aberrations	$\leqslant \pm$ 3% ($\leqslant$ 4% pp)	Measured at 6 div. amplitude and applied rise time of $\geqslant$ 1 ns.
	Deflection coefficients	2 mV/DIV .... 10 V/DIV	1-2-5 sequence
	Continuous control range	1 : $\geqslant$ 2,5	
	Deflection accuracy	$\pm$ 3 %	
	Input impedance	1 MΩ/20 pF	
	Input RC time	0,1 s	Coupling switch to AC
	Maximum permissible input voltage	400 V, d.c. + a.c. peak	
	Chopping frequency	$\approx$ 500 kHz	
	Vertical positioning range	16 divisions	
	Dynamic range	24 divisions	
	Visible signal delay	$\geqslant$ 2 divisions	At 10ns
	C.M.R.R. in A-B mode	$\geqslant$ 40 dB at 1 MHz	After adjustment at d.c. or low frequencies
	Cross talk between channels	-40 dB or better at 10 MHz	Both attenuators in the same setting
	Instability of the spot position:		
	Temperature drift	$\leqslant$ 0,3 div/hour	

1.2.3 Horizontal or X-axis

Horizontal deflection can be obtained from either the Main time base or the Delayed time base or a combination of the two, or from the signal source selected for X-deflection. In this case X-Y diagrams can be displayed using A, B, the Ext input connector, or Line as a signal source for horizontal deflection.

Display modes	– Main time base – Main time base intensified by delayed time base – Main time base and delayed time base alternately displayed – Delayed time base – XY or XY/Y operation	X deflection by: – Channel A signal – Channel B signal – Signal applied to EXT connector of main time base – Line frequency

1.2.4 Main time base

Operation	Automatic	Possibility of automatic free-running in the absence of triggering signals
	Triggered	
Time coefficients	0,5 s/DIV ..... 0,1 µs/DIV	1-2-5 sequence
Continuous control range	1 : ⩾ 2,5	
Coefficient error	± 3%	± 5% including x10 magnifier
Magnification	10x	
Max. effective time coefficient	10 ns/DIV	

1.2.5 Delayed time base

Operation	Delayed time base either starts immediately after delay time or is triggerable after the delay time, by the selected delayed time base trigger source	
Time coefficients	1 ms/DIV – 0,1 µs/DIV	1-2-5 sequence
Continuous control range	1 : ⩾ 2,5	
Coefficient error	± 3%	
Delay time	In steps variable with main time base. Continuously variable with 10-turn potentiometer between 0 x and 10 x the time coefficient of the main time base	
Incremental delay time accuracy	0,5%	
Delay time jitter	1 : ⩾ 20.000	

	Designation	*Specification*	*Additional information*
1.2.6	**X Deflection**		
	Source	A, B, EXT, EXT ÷ 10 or LINE	As selected by trigger source switch, if push-button X DEFL. is depressed
	Deflection coefficients	A or B: As selected by AMPL/DIV EXTERNAL : 0,2 DIV EXT ÷ 10 : 2V/DIV LINE 8 divisions at nominal line voltage.	
	Deflection accuracy	± 10%	
	Frequency range	DC: 0 .... 1 MHz (-3 dB) over 6 divisions	
	Phase shift	$\leqslant 3^\circ$ at 100 kHz	
	Dynamic range	24 divisions	For frequencies $\leqslant$ 100 kHz
1.2.7	**Triggering of the main time base**		
	Source	Ch. A, Ch. B, Composite, External ÷ 10 and line	
	Trigger mode	Automatic, normal AC normal DC, TV-line and TV frame	
	Trigger sensitivity	Internal: 0,5 div (DC ..... 5 MHz) 1 div (DC ..... 50 MHz) External : 150 mV (DC ..... 5MHz) 200 mV (DC ..... 50MHz) Ext. ÷ 10 : 1,5V (DC ..... 5MHz) 2V (DC ..... 50MHz)	
	Triggering frequency range	AUTO: 20 Hz..... $\geqslant$ 50 MHz AC: 5 Hz..... $\geqslant$ 50 MHz DC: 0 Hz..... $\geqslant$ 50 MHz	
	Level range	AUTO: Proportional to peak-to-peak value of trigger signal. AC, DC: 16 div. at Internal trigg., 3,2 V at external trigg., and 32V at ext. ÷ 10	+ or −8 div and +or −1,6V referenced to centre of screen + or −16V referenced to centre of screen
	Triggering slope	Positive or negative going	
	Input impedance	1 MΩ//20 pF	
	Maximum permissible input voltage	400 V, d.c. + a.c. peak	
	Hold-off time	variable	
1.2.8	**Triggering of the delayed time base**		
	Source	chA, chB, Composite, External, MTB.	

Other trigger specifications are identical to "triggering of the main time base" with the exception of the trigger modes EXT. ÷ 10, TV and AUTO.

1.2.9	**Calibration generator**		
	Output voltage	1,2 Vpp	Square wave
	Accuracy	± 1%	
	Frequency	≈ 2 kHz	

	Designation	*Specification*	*Additional Information*
1.2.10	**Power supply**		
	AC supply:	Double insulated	Safety class II, IEC 348
	Nominal voltage range (on line-mains voltage adaptor)	110, 127, 220 or 240 Vac ± 10%	
	Nominal frequency range	50 ..... 400 Hz ± 10%	
	Power consumption	30 W max.	At nominal mains voltage
	DC supply:		
	Voltage range	22-27 V dc 20-28 V	Floating input with relaxed specifications
	Current consumption	1,1 A max.	
	Capacity to earth	185 pF	Measured with rubber feet on grounded metal plate of 1 m^2
		27 pF	Measured 30 cm above grounded plate of 1 m^2

1.2.11. Environmental characteristics

The environmental data are valid only if the instrument is checked in accordance with the offical checking procedure. Details on these procedures and failure criteria are supplied on request by the PHILIPS organisation in your country, or by N.V. PHILIPS' GLOEILAMPENFABRIEKEN, TEST AND MEASURING DEPARTMENT, EINDHOVEN, THE NETHERLANDS.

Ambient temperatures:	
Rated range of use	+ 5°C ... +40°C
Operating	−10°C ... +55°C
Storage and transport	−40°C ... +70°C
Altitude:	
Operating to	5000 m (15000 ft)
Non-operating to	15000 m (45000 ft)
Humidity	21 days cyclic damp heat 25°C −40°C, R.H. 95%
Shock	30 g: half sinewave shock of 11ms duration: 3 shocks per direction for a total of 18 shocks
Vibration	Vibrations in three directions with a maximum of 15 min. per direction, 5 – 55 Hz and amplitude of 0.7mm_{pp} and 49 max. acceleration. Unit mounted on vibration table without shock absorbing material.
Electromagnetic interference	Meets VDE 0871 and VDE 0875 Grenzwertklasse B.
Safety	The isolation between the oscilloscopes and line fulfills the safety requirements of IEC 348 for metal encased class II instruments.

1.2.12 Mechanical data

Dimensions:		
Length	445 mm	Handle and controls excluded
Width	335 mm	Handle excluded
Height	137 mm	Feet excluded
Weight	8,4 kg (18,5 lb) approx.	

1.2.13. Z-mod input TTL compatible "0" blanks display "1" normal intensity see chapter 3.6.

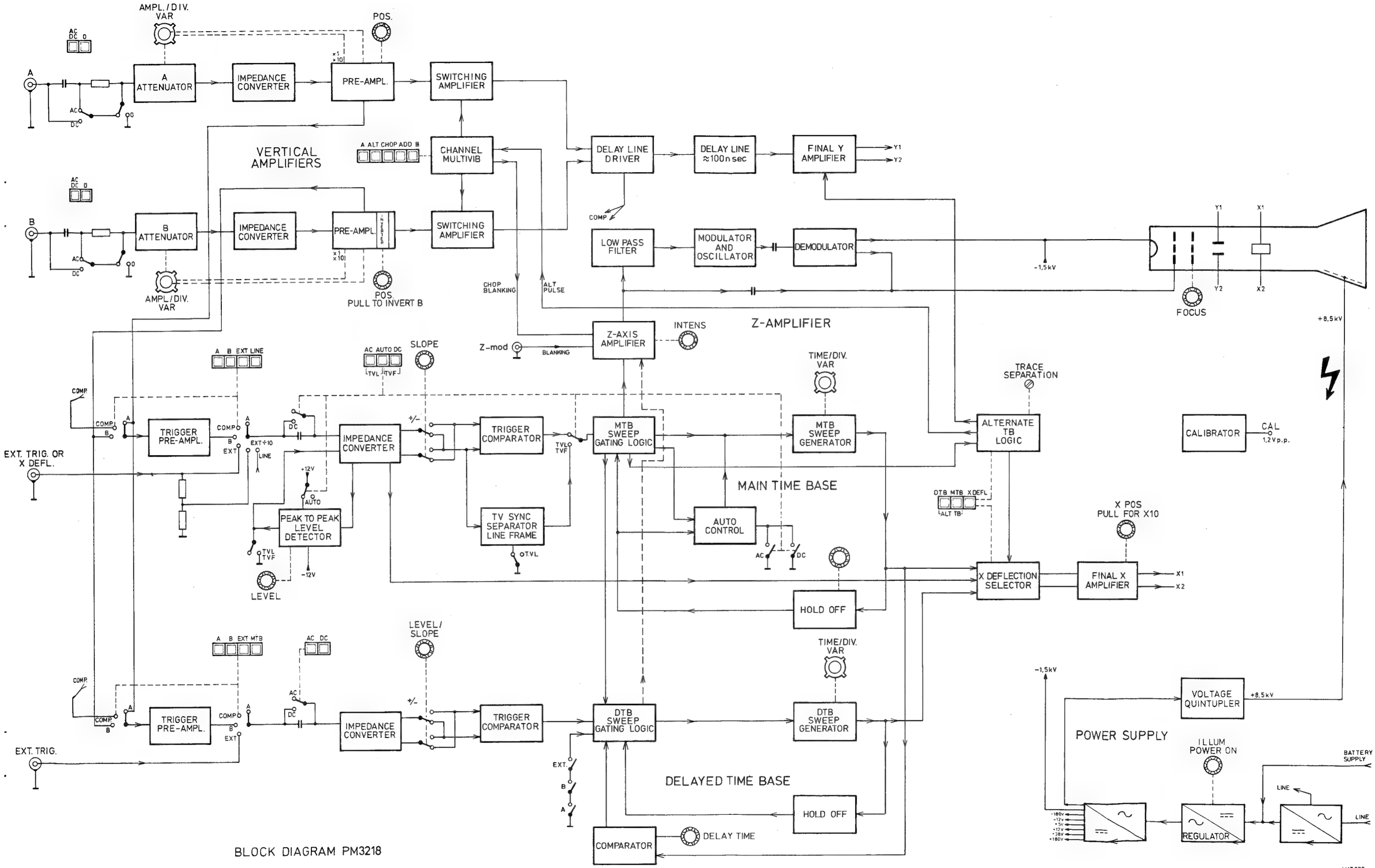
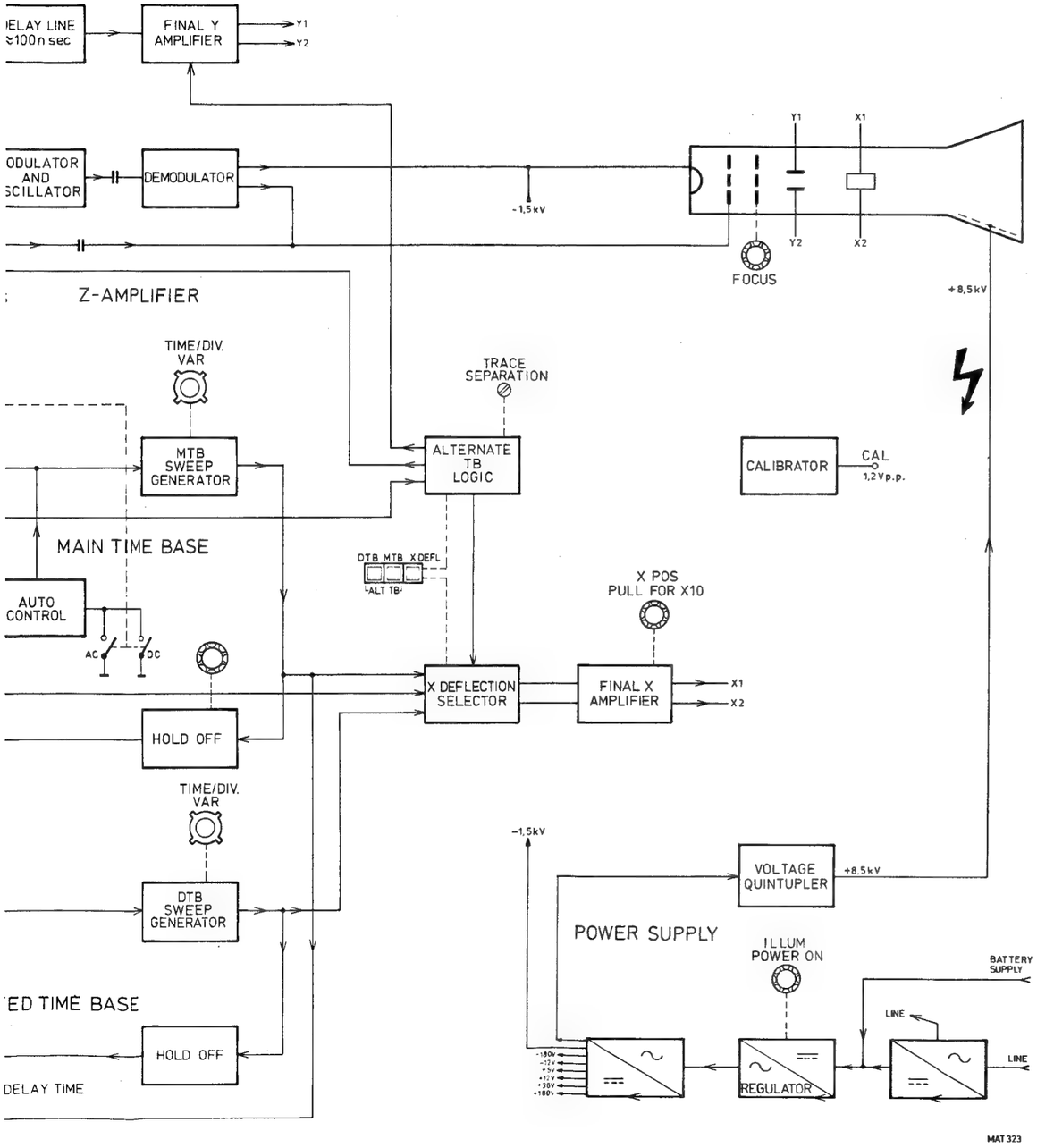


Fig. 1.3. Block diagram



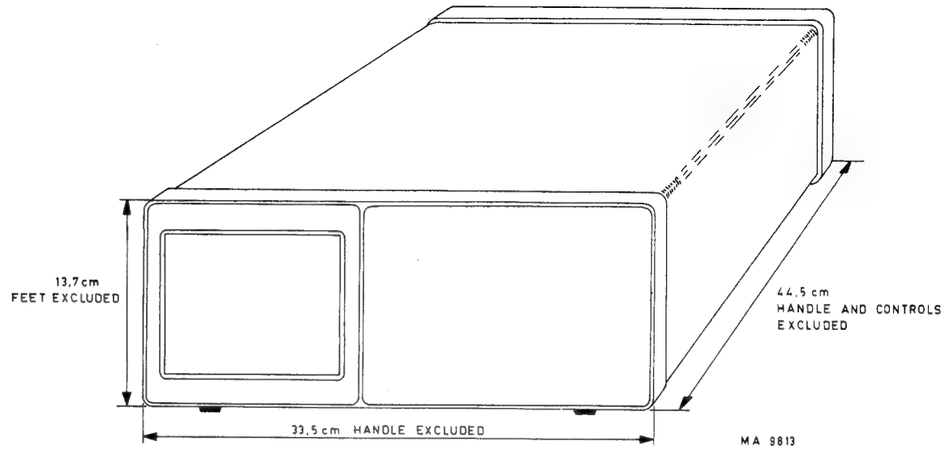


Fig. 1.2. Dimensions

1.3. ACCESSORIES

1.3.1. Supplied with the instrument

Front cover
2 BNC 4 mm adaptor
2 Probes
Instruction manual

1.3.2. Optional

PM 8925	Passive probe set 10 : 1 (1.5 m) 40 MHz
PM 8925L	Passive probe set 10 : 1 (2.5 m) 40 MHz
PM 8921	Passive probe set 1 : 1 (1.5 m) 15 MHz
PM 8921L	Passive probe set 1 : 1 (2.5 m) 15 MHz
PM 8940	Isolation amplifier
PM 8943	1 : 1, 10 : 1 and 100 : 1 650 MHz FET-probe
PM 9355	Current probe
PM 8910	Polaroid anti-glare filter
PM 9380	Oscilloscope camera
PM 8971	Camera adaptor
PM 8962	19" Rack mount adaptor
PM 9366	Collapsible viewing hood
PM 8980	Closed long type viewing hood
PM 8901	Rechargeable battery pack 330 V d.c./24 V d.c.
PM 8991	Trolley
PM 8992/01	Accessory pouch
Trimming tool kit	

See also Chapter 3.5. "INFORMATION CONCERNING ACCESSORIES".

1.4. BLOCK DIAGRAM DESCRIPTION (Fig. 1.3.)

1.4.1. Y Channel

The vertical channels A and B for the signals to be displayed are identical, each comprising an input coupling switch, an input step attenuator, an impedance converter and a preamplifier with trigger pick-off.

A channel multivibrator, controlled by the display mode pushbuttons, switches either channel A or channel B to the final Y amplifier via the delay line. The channel multivibrator is operated by a pulse at the end of the sweep, and offers an uninterrupted display of the A and B waveforms in the ALT mode. In the ADD position, both switching amplifiers couple the signals through, thus adding channels A and B. By inverting the B channel amplifier (PULL TO INVERT B) the A – B mode is obtained.

The AMPL/DIV switches provide x 1 or x 10 gain control of the preamplifier, which offers in conjunction with the step attenuator a full range of deflection coefficients in a 1-2-5 sequence.

1.4.2. Main time base triggering

To initiate sweeps, trigger signals can be derived from the A and B vertical channel preamplifiers, from an external source, or internally from the mains supply (LINE triggering) as selected by the trigger source switch. Composite triggering (A and B depressed) is derived from the delay-line driver stage. The polarity of the trigger signal, negative or positive-going, on which the display will start is determined by changing the output polarity of the impedance converter.

With the AUTO switch depressed, the peak-to-peak level detector comes into operation. The peak-to-peak level of the signal then determines the range of the LEVEL control.

With AC or DC depressed, the range of the LEVEL control is fixed.

In the TVL and TVF modes the LEVEL control is inoperative and the TV sync separator is switched into circuit, thus initiating sweeps with line or frame pulses depending on the setting of the TVL and TVF switches.

1.4.3. Main time base circuit

For normal internal time base operation the horizontal amplifier is fed by sweeps from the time base circuit. With AUTO depressed, in the absence of trigger signals, the output of the sweep generator is fed back via the hold-off circuit and gate to its input. This causes sweeps to free-run and a resultant trace is displayed on the screen. As soon as the AUTO control circuit detects a trigger (i.e. a change in the output of the sweep-gating logic) the sweep is fed back to the sweep-gating logic. This causes the circuit to revert to the normal triggering mode in which sweeps are initiated only by trigger pulses at the input of the sweep-gating logic.

With AC or DC depressed, AUTO control is made inoperative. Sweeps are then only produced provided a trigger signal is present and the LEVEL control appropriately set.
The display can be magnified in the horizontal direction by increasing the gain of the final amplifier by a factor of x10 (also the X DEFL mode).

When the X DEFL pushbutton of the horizontal selection switch is depressed, the sweep generator output to the final amplifier is inhibited and the impedance converter is connected directly to the final amplifier. In this way, the signals normally selected for triggering, or an external source, can now be used for horizontal deflection.

1.4.4. Hold-off circuit

The hold-off stage, as its name implies, "holds-off" triggers from the input of the time base circuit until the trace has completely returned and the time base circuits are completely reset. The hold-off time can be decreased by turning the HOLD-OFF control clockwise.

1.4.5. Z Axis

The Z amplifier provides for the blanking of the trace during the fly-back and hold-off time. In addition, it blanks the sweep in the CHOP mode during the switching transients. More over the trace can be blanked by a signal applied to the external Z-mod input. The l.f. components of the blanking signal are modulated and demodulated before they are applied to the Wehnelt cylinder together with the a.c. coupled h.f. components.

1.4.6. Delayed time base triggering

To initiate sweeps, trigger signals can be derived from the A and B vertical channel preamplifiers, or from an external source as selected by the trigger source push button switch.

With both the A and B pushbuttons depressed simultaneously, composite triggering is derived from the delay-line driver stage of the Y amplifier channel. AC and DC coupling is provided to the impedance converter. The polarity of the trigger signal, negative or positive-going, on which the display will start, is determined by changing the output polarity of the impedance converter by the SLOPE switch.

With MTB selected, the delayed time base starts directly after the delay time. The DELAY TIME control in conjunction with the comparator determines the delay time for the delayed time base generator.

1.4.7. Delayed time base circuit

The delayed time base is operative unless its TIME/DIV switch is in the OFF position. It starts immediately after the delay time, or upon receipt of the first trigger pulse after the delay time.

The sawtooth signal derived from the main time base sweep generator is passed to a comparator where it is compared with an accurately adjustable d.c. voltage, controlled by the DELAY TIME control.

The comparator output is pulse-shaped and provides the required delay pulse for the sweep-gating logic of the delayed time base generator. A sawtooth voltage is then initiated.

The delayed sweep is reset by the hold-off circuit of the delayed time base (end of the sweep detection) or by the main time base.

It can be started again by the output signal of the comparator after the initiation of the next main time base sweep.

When pushbutton MTB of the horizontal deflection mode controls is selected, the part of the trace coinciding with the delayed sweep is intensified.

1.4.8. Alternate time base logic

In ALT TB mode an electronic switch enables main time base display and delayed time base display to be alternately traced on the screen.

The two displays can be separated by varying the voltage applied to the vertical amplifier, derived from the driving circuits of the electronic switch. This separation is symmetrically variable by means of the TRACE SEPARATION control on the front panel.

In the ALT TB mode the vertical channel multivibrator is controlled by a signal derived from the electronic switch.

In the vertical and horizontal ALT modes, successively are displayed on the screen, Channel A and main time base, Channel A and delayed time base, Channel B and main time base, Channel B and delayed time base.

1.4.9. Power supply

The mains (line) supply is transformed and rectified before being applied to a d.c. to a.c. converter. When the instrument is operated from a battery supply, the battery output is connected directly to the d.c. to a.c. converter.

The output of the regulator is coupled to a transformer and rectifier which, after rectification, provides the -1.5 kV potential and the circuit supply voltages. The -1.5 kV is also multiplied to 8.5 kV to supply the required total accelerating voltage of ≈ 10 kV.

2. Directions for use

2.1 INSTALLATION

2.1.1 Safety regulations (in accordance with IEC 348)

Before connecting the instrument to the mains (line), visually check the cabinet, controls and connectors etc. to ascertain whether any damage has occurred in transit. If any defects are apparent, do not connect the instrument to the mains (line).

The instrument must be disconnected from all voltage sources and any high voltage points discharged before any maintenance or repair work is carried out. If adjustments or maintenance of the operating instrument with covers removed is inevitable, it must be carried out only by a skilled person who is aware of the hazards involved. In normal operation the double-insulated power supply obviates the need of a safety ground.

> **Warning:** **It must be borne in mind that in all measurements the frame ground of the oscilloscope is raised to the same potential as that of the measuring ground probe connection. Neither the probe's ground lead nor the frame ground shall be connected to live potentials.**

2.1.2 Local mains (line) connection and fuse protection

Before connecting the instrument to the mains (line) ensure that it is set to the local mains (line) voltage. On delivery the instrument is set to 220 V. If the instrument is to be used with 110 V, 127 V or 240 V supply, the appropriate voltage should be selected by turning the adaptor on the rear panel to indicate the voltage required (see Fig. 2.1).

The instrument is protected from overloads by a thermal fuse fitted between the mains (line) transformer windings. It can be replaced after having removed the instrument rear panel (see section 2.4.)

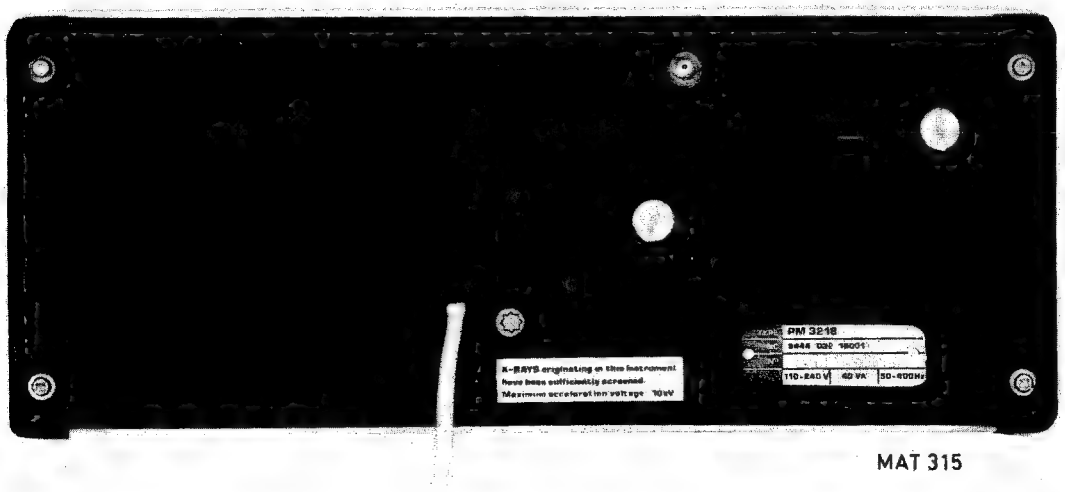


Fig. 2.1. Rear view of the oscilloscope showing the voltage adapter set to 220 V.

2.1.3 Connection to an external supply

An external supply or battery of 22 V to 27 V capable of delivering at least 1 A can be connected to the socket on the rear panel. (DC Power input cord set: 4822 321 20125).
The inner conductor must be connected to the negative pole and the outer conductor to the positive pole, as indicated on the rear panel.
The instrument is protected against overloads and reversed polarity by an internal fuse and diode. This fuse can be replaced after having removed the instrument rear panel (see section 2.4.).

2.1.4 Front cover and instrument position

The front cover can be simply removed by pulling it from the front.
The instrument may be used horizontally or in several sloping positions by using the carrying handle as a tilting bracket.
To unlock the handle, simultaneously push in both pivot centre knobs.

2.2 CONTROLS AND SOCKETS (Refer to Fig. 2.2)

2.2.1 Cathode-ray tube and POWER controls

ILLUM POWER ON	Continuously variable control of the graticule illumination; incorporates mains (line) switch. POWER ON pilot lamp indicates the ON state.
INTENS	Continuously variable control of the trace brilliance.
FOCUS	Allows beam to be focused for minimum spot size.
TRACE ROTATION	Screwdriver adjustment to align the trace with the horizontal graticule lines.

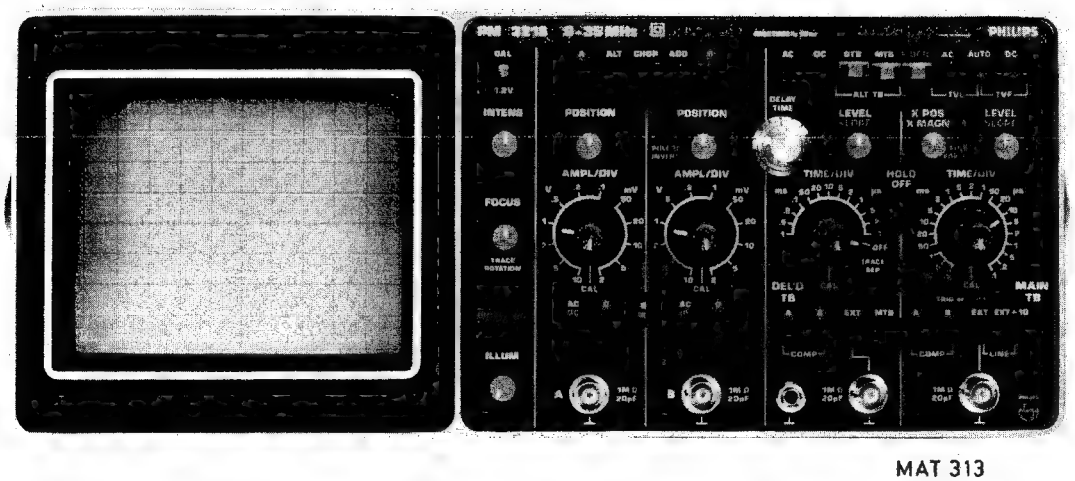


Fig. 2.2. Front view of the oscilloscope showing controls and sockets.

2.2.2 Vertical channels

Display mode switch	*Function*
A – ALT – CHOP – ADD – B	5-way pushbutton switch selecting the vertical display mode. With all buttons released, the ALT mode is in operation.
A	Vertical deflection is achieved by the signal connected to the input of channel A.
ALT	The display is switched over from one vertical channel to the other at the end of every cycle of the timebase signal.
CHOP	The display is switched over from one vertical channel to the other at a fixed frequency. ($f \approx 500$ kHz)
ADD	Vertical deflection is achieved by the sum signal of channels A and B.
B	Vertical deflection is achieved by the signal connected to the input of channel B.
POSITION	Continuously variable controls giving vertical shift of the display.
PULL TO INVERT B	Push-pull switch combined with the channel B POSITION control. When pulled, channel B signal is inverted.
AMPL/DIV (outer-knob)	Step control of the vertical deflection coefficients, ranging from 2 mV/div up to 10 V/div in a 1-2-5 sequence.
AMPL/DIV (centre-knob)	Continuously variable control of the vertical deflection coefficients. Note that the deflection coefficient is calibrated only with the centre-knob switched to the CAL position (fully-clockwise).
Input coupling switch	Signal coupling; 2-way pushbutton switch
AC/DC – 0	
AC (depressed)	Coupling via a blocking capacitor
DC (released)	Direct coupling
0 (depressed)	Connection between input circuit and input socket is interrupted and the input circuit is grounded.
A (1MΩ//20pF)	BNC socket for channel A input
B (1MΩ//20pF)	BNC socket for channel B input

2.2.3 Horizontal channel

X deflection source switch	*Function*
DTB MTB – XDEFL └ALT TB┘	Horizontal-deflection controls; 3-way pushbutton switch
DTB	The horizontal deflection voltage is supplied by the delayed time-base generator.
MTB	The horizontal deflection voltage is supplied by the main timebase generator. A portion of the trace is intensified when the delayed timebase is running. The delayed timebase generator is switched off when the DELD TIME/DIV switch is in the OFF position. If no buttons are depressed the effect is the same as the MTB button depressed (only the MTB LEVEL control is not operating in this situation).
DTB MTB └ALT TB┘	When both the DTB and MTB pushbuttons are selected simultaneously, the horizontal deflection voltage is supplied by the main and delayed timebases alternately.
X DEFL	Horizontal deflection is achieved by the channel A signal, the channel B signal, the mainsfrequency signal or an external signal applied to the external input socket of the main time base.

X POS/X MAGN	Continuously variable control giving horizontal shift of the display; incorporates a push-pull switch, PULL FOR x 10, which increases the horizontal deflection coefficient by a factor of 10. The magnifier is also operative if an external X deflection signal is used.
TRACE SEP	Continuously variable control of the vertical space between the two time-base displays in the ALT.TB mode.

2.2.4 Main time base generator

LEVEL SLOPE (IN +,OUT–)	Continuously variable control to select the level of the triggering signal at which the timebase generator starts. This control incorporates a push-pull switch, which enables choice of triggering on the positive or negative-going edge of the triggering signal. For TV triggering, select – for negative video signals and + for positive video signals.
Trigger mode switch	*Function*
AC – AUTO – DC └ TVL ┘└TVF┘	3-way pushbutton switch selecting the trigger mode. With all pushbuttons released AUTO sweep mode is in operation at a fixed range of the LEVEL control.
AUTO	A trace is displayed in the absence of trigger signals. The range of the LEVEL control is proportional to the peak-to-peak value of the triggering signal.
AC	Normal triggering and fixed range of the LEVEL control. The DC component of the trigger signal is blocked.
DC	Normal triggering and fixed range of the LEVEL control. The DC component of the trigger signal is passed.
AC AUTO └ TVL ┘	Line synchronisation is obtained.
AUTO DC └ TVF┘	Frame synchronisation is obtained.
HOLD OFF	Continuously variable control of hold-off time
Trigger source switch	*Function*
A – B–EXT – EXT÷10 └COMP┘ └ LINE ┘	4-way pushbutton switch selects the trigger source, (or the source of horizontal deflection if X deflection source switch is depressed for X DEFL). With all pushbuttons released, the effect is the same as the A button depressed.
A	Signal derived from channel A
B	Signal derived from channel B
A B └COMP┘	Composite signal, derived after the electronic switch. Triggering occurs on the displayed waveforms (not usable with X DEFL).
EXT and EXT÷10	External signal derived via the adjacent 1 MΩ//20pF socket.
LINE (MAINS)	Signal derived from the line (mains) voltage. (Inoperable when instrument is battery-powered).
TIME/DIV (outer switch)	Selects the time coefficient from .1 μs/div to .5 s/div in a 1-2-5 sequence.
TIME/DIV (inner knob)	Continuously variable control of the time coefficients. Must be switched to CAL position (i.e. fully clockwise) for the time axis to be calibrated according to the indication of the TIME/DIV switch.
1 MΩ – 20 pF	BNC socket for external triggering or horizontal deflection.

2.2.5 Delayed time base generator

LEVEL SLOPE (IN +, OUT –)	Continuously variable control to select over a fixed range the level of the triggering signal at which the time base generator starts. This control incorporates a push-pull switch, which enables choice of triggering on the positive or negative going edge of the triggering signal.
Trigger mode switch	*Function*
AC – DC	2-way pushbutton switch selecting the trigger mode
AC	Normal triggering and fixed range of the LEVEL control. The DC component of the trigger signal is blocked.
DC	Normal triggering and fixed range of LEVEL control. The DC component of the trigger signal is passed.
DELAY TIME	Continuously variable vernier control of the delay time, together with the TIME/DIV controls of the main time base generator.
Trigger source switch	*Function*
A – B – EXT – MTB └COMP┘	4-way pushbutton switch selects the trigger source and starting point of delayed time base. No pushbutton depressed has the same effect as the MTB button depressed.
A	Internal triggering Signal derived from channel A.
B	Internal triggering Signal derived from channel B.
A B └COMP┘	Composite signal, derived after the electronic channel switch. Triggering occurs on the displayed waveform, after selected delay time.
EXT	Triggering on an external signal connected to the adjacent 1MΩ//20pF socket.
MTB	Internal triggering signal derived from the main time base to start the delayed time base immediately after the selected delay time.
TIME/DIV (outer switch)	Selects the time coefficient from .1 μs/div to 1 ms/div in a 1-2-5 sequence. Incorporates an OFF position by which the delayed time base generator is switched off.
TIME/DIV (inner knob)	Continuously variable control of the time coefficients. Must be in the CAL position (i.e. fully clockwise) for the time axis to be calibrated according to the indication of the TIME/DIV switch.
1MΩ – 20 pF	BNC socket for external triggering signal.

2.2.6 Miscellaneous

CAL	Output socket supplying squarewave voltage ≈ 2 kHz at an amplitude of 1.2 V p-p ± 1%. To be used for probe compensation and/or checking vertical deflection accuracy.
DC POWER IN	Input socket at the rear of the instrument allows operation by an external d.c. supply. Rated supply voltage 22 V to 27 V, current capability > 1A.
LINE (MAINS) VOLTAGE ADAPTOR	Must be set according to section 2.1.2 before the instrument is connected to the local mains voltage.
Z-MOD	See chapter 3.6.

2.3 OPERATING INSTRUCTIONS

2.3.1 Switching on the instrument

Before connecting the instrument to any supply, the instructions given in section 2.1 Installation, should be carefully carried out.

The oscilloscope will meet specifications (see section 1.2) normally after a warming-up period of approximately 15 minutes. However, if the instrument has been subjected to an extremely cold environment (e.g. left in a car overnight in freezing conditions) and is then brought in for use in a warm room, a warming-up period of sufficient length should be allowed (see 1.2.11).

2.3.2 Preliminary settings of the controls

This procedure is a general indication of whether the oscilloscope is functioning correctly and provides a suitable starting point before any measurements are made.

Refer to Fig. 2.2 for location of controls.

Set INTENS and FOCUS controls in mid position.

Depress AUTO and select an average time coefficient between 10 μs/div and 10 ms/div with the TIME/DIV switch. With all other pushbuttons normal (not depressed) channel A and channel B traces can be positioned on the screen with the relevant POSITION controls. Set the INTENS control for a display of medium brightness and adjust FOCUS control for well focused traces.

2.3.3 Input coupling (AC/DC, 0)

AC coupling (pushbutton depressed) is useful to block the d.c. component of a signal. Choice of AC limits the lower frequencies, causing low repetition rate sinewave signals to be attenuated and low repetition rate squarewaves to be distorted. The degree of attenuation is determined by the input RC time (0.1s). Input RC time is extended by 10 if 10:1 passive probes are employed.

When switching to AC coupling it will take approximately five input RC times before the trace is stabilised to the average value of the input signal.

AC position measurements cannot be made with respect to ground.

0 position disconnects input source and short-circuits input of amplifier to provide zero signal check.

DC coupling (pushbutton released) provides for full range frequency input, i.e. down to d.c.

2.3.4 Use of probes

1:1 passive probes should only be used for d.c. and low frequencies.
Capacitive loading attenuates high frequencies or increases the rise-time of measurement signals (dependent on source impedance).

10:1 passive probes have less capacitive loading; usually about 10pF to 20pF. FET probes are superior, especially when measurements are to be taken from high impedance test points or at the upper frequency limit of the oscilloscope bandwidth.

10:1 passive probes must be properly compensated before use. Incorrect compensation leads to pulse distortion or amplitude errors at high frequencies.
For correct adjustment, the CAL output connection can be used (see Fig. 2.3.)

2.3.5. Adjustment of attenuator probes

- Connect the compensation box to socket A and place the tip of the probe on socket CAL.
- Insert a small screwdriver through the hole in the compensation box and adjust the trimmer to obtain a correct display as shown in Fig. 2.3.

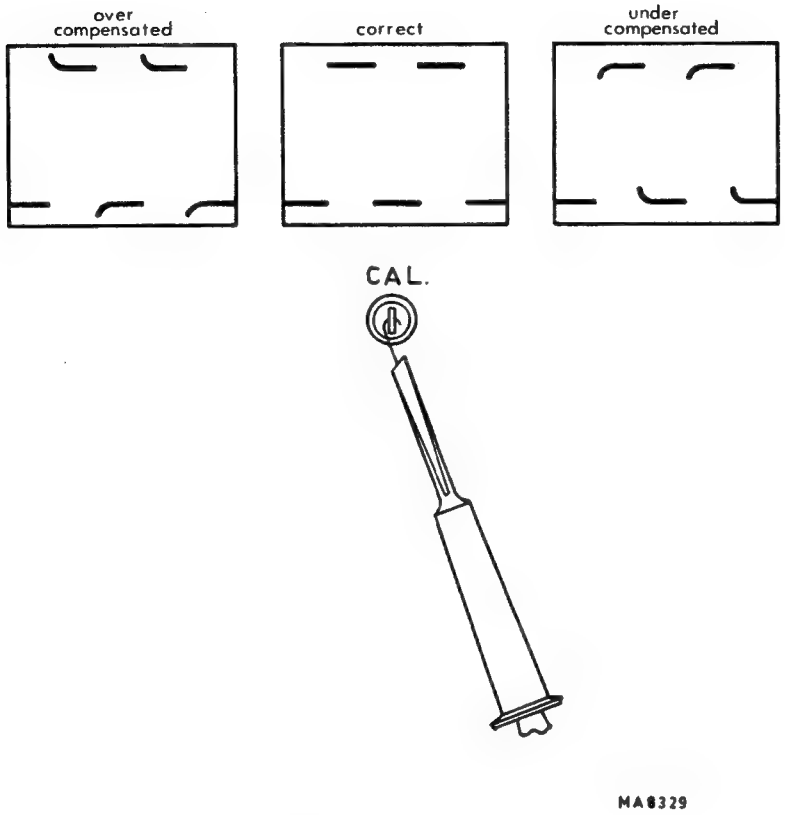


Fig. 2.3. Adjusting an attenuator probe

2.3.6. Selection of chopped or alternate modes

(A ALT CHOP ADD B)

In dual channel operations (CHOP or ALT depressed) the chopped mode (depress CHOP) must be selected for relatively slow sweep speeds (from .1 ms/div to .5 s/div) or at low repetition rates of sweeps occuring, even at high sweep rates. Selection of the ALTernate mode under these circumstances would make comparisons between waveforms difficult because traces would actually appear to be written one by one. However, when the display is fast enough to be interrupted by the chopping frequency the alternate mode must be selected (depress ALT), usually at sweep rates faster than .1 ms/div.

2.3.7. Differential mode

The A – B mode can be selected by depressing ADD and pulling the channel B POSITION control.

In measurements where signal lines carry substantial common mode signals (e.g. hum) the differential mode will cancel out these signals and leave the remainder of interest (A – B). The capability of the oscilloscope to suppress common mode signals is given by the CMR factor (see Fig. 2.4).

To obtain the degree of common mode rejection as specified, channel A and B gains must first be equalised. This can be done by connecting both channels to the CAL output connector, and adjusting one of the continuous controls with the AMPL/DIV switch for minimum deflection on the screen.

When passive 10:1 probes are used a similar equalisation process is recommended by adjusting their compensating controls for minimum deflection.

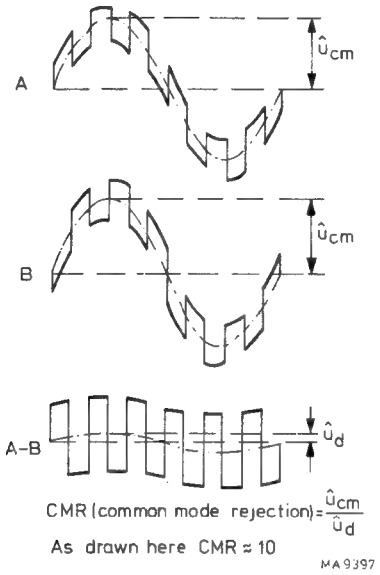


Fig. 2.4. Suppression of common mode signals

2.3.8. Selection of trigger mode

(AC AUTO DC)
└TVL ┘└ TVF ┘

The AUTO mode is most useful because it provides trace(s) on the screen even in the absence of trigger signals. Furthermore, for a signal amplitude larger than 1 division, this mode provides stable triggering independently of the position of the LEVEL control; its range is automatically adjusted to the peak-to-peak value of the signal selected for triggering.

In this way the setting of the LEVEL control is facilitated at small amplitudes of the trigger signal.

The AUTO mode cannot be employed for signals with low repetition rates (10 Hz or lower) because the sweeps would be able to free run in between triggers. Therefore, for low repetition signals normal triggering must be used (AC or DC depressed).

In normal triggering, sweeps are only initiated with a trigger signal applied and the LEVEL control set appropriately.

With AC or DC depressed the range of the LEVEL control is fixed (+ or –8 divisions or more at the extremes of the LEVEL control with respect to mid screen).

The DC component in the trigger signal can be blocked by depressing AC. This is useful when triggering must take place on a.c. signals superimposed on a large d.c. level.

With AC coupling, the level at which the display starts will change with alterations in the average value of the trigger signal. The trigger level is thus no longer referenced to signal ground. This may cause instability with waveforms that vary in time interval from cycle to cycle. Normally it is preferable to use the DC position.

Slope selection is made with pushbutton +/–. In TV mode – must be selected for negative video signals and + for positive video signals. The LEVEL control is inoperable in the TV mode.

No buttons depressed offers an extra mode of use, a trace is on screen in the absence of a trigger signal, but the LEVEL range is fixed.

2.3.9. Trigger sources

The main time base trigger sources can be selected by the front-panel TRIG or X DEFL pushbuttons.

A B EXT EXT÷10
└COMP┘ └LINE┘

- *Internal triggering* will be most commonly used because it requires only one signal (the input signal) to obtain stable triggering.
- *External triggering.* When tracing many signals it is advantageous to use an external signal for triggering. There is no need to set and reset the trigger controls (LEVEL, SLOPE and SOURCE) on changing the input signal. Furthermore the two A and B inputs remain free for examining waveforms.
- *Selection of trigger source.* In comparing waveforms that are a multiple of each other's frequency, always select the signal, that has the lowest repetition rate as the trigger source. Not doing so may lead to double pictures (chopped mode) or untrue time-shifts (alternate mode).
- *Composite triggering.* With internal triggering signals are obtained from either the A channel, the B channel preamplifier stages or, when COMP is selected by depressing both A and B pushbuttons, from the delay line driver stage that follows the electronic channel switch.

  Composite triggering offers three advantages:

1. In differential mode (A – B measurements) triggering is derived from the differential signal. Triggering is not disturbed by common mode signals.
2. For one channel operation it is not necessary to switch trigger sources from A to B or vice versa.
3. In the alternate mode, it is possible to compare signals that are not related in time.

Note: When composite triggering is employed in dual channel operation (chopped or alternate), and there is only one signal applied (to A or B input), stable triggering cannot be obtained. This is only normal since the trigger source is also switched from A to B (see Fig. 2.5).

- *Line (mains) triggering* is useful when the signal input is mains (line) frequency related.

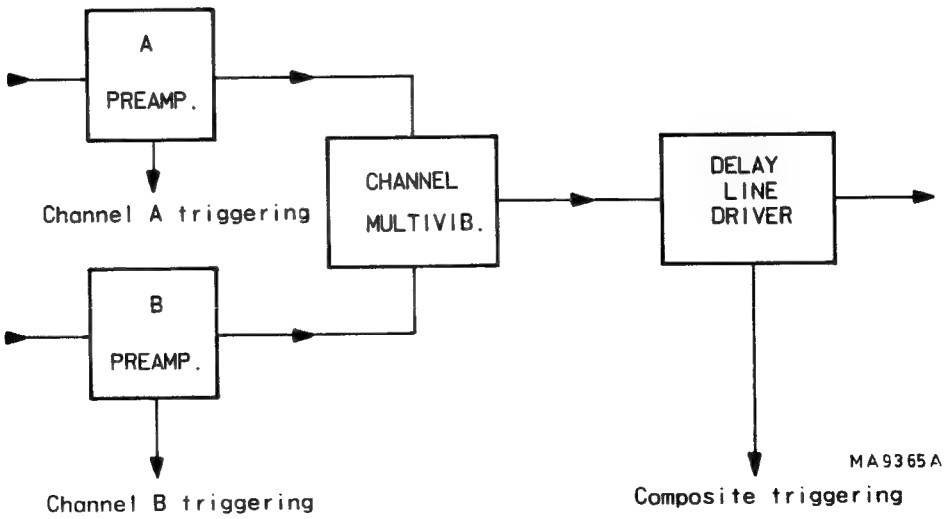


Fig. 2.5. Block diagram of composite trigger circuit

2.3.10. Time-base magnifier

The magnifier is operated by pulling the switch incorporated in the X position control.
When this switch is in the x10 position, the time-base sweep speed is increased 10 times. The sweep time is therefore determined by dividing the indicated TIME/DIV value by 10.

2.3.11. Hold-off.

This control can be used to increase the sweep hold-off time.

2.3.12. XY Measurements

XY measurements are made with the TIME/DIV switch at EXT X DEFL, the source of horizontal deflection being selected by the TRIG or X DEFL pushbutton switch (A, B, EXT, EXT ÷ 10 or LINE)
XY measurements provide a useful means of making frequency or phase shift comparisons by displaying Lissajous patterns.
Measurements can be made up to 100 kHz with less than 3^{o} phase error between horizontal and vertical channels.

The sensitivity for the different XY modes is shown in the following table:

X deflection	Sensitivity
A	AMPL/DIV A ± 10%
B	AMPL/DIV B ± 10%
EXT	0.2 V/DIV
EXT ÷ 10	2 V/DIV
LINE	8 divisions

2.3.13. Using the Delayed time-base

The delayed time base can be used for the accurate study of complex signals. The delayed time base generator starts (TIME/DIV switch not at OFF) after the selected delay time and the delayed signal is intensified when the MTB pushbutton of the horizontal deflection controls has been selected.
The DELAY TIME potentiometer control enables the intensified portion to be shifted along the time axis. The duration of the intensified portion, its length, can be controlled in steps and continuously by means of the TIME/DIV controls of the delayed time base generator. When pushbutton DTB of the horizontal deflection controls is depressed, the intensified portion occupies the full width of the screen.

In the DTB position, the delay time (i.e. the interval between the starting points of the main time base and that of the delayed time base) is determined by the setting of the main time base TIME/DIV controls and the DELAY TIME control. The PM3218 is equipped with display switching. This offers the instrument user a simultaneous display of the signal on the two time scales provided by the main time base and by the delayed time base.

By selecting ALT TB, detailed examination of a certain portion of the main time base display is enabled by expanding the time interval of interest, using the delayed time base.

Expansion is achieved by selecting a correspondingly faster sweep for the delayed time base TIME/DIV control and positioning the time interval by the DELAY TIME potentiometer.

The part of the signal under detailed observation by the delayed time base also remains as an intensified portion of the main time base display. This not only facilitates the location of the required detail during dialling, but also serves as a visual indication of the portion of the overall trace being examined. Selection of ALT TB thus enables immediate correlation of the detail with the overall signal, which may be extremely complex, without the need to switch between MTB and DTB.

2.4. PROCEDURES REQUIRED FOR THE REMOVAL OF FUSES, BEZEL AND CONTRAST PLATE

2.4.1. Removing the instrument covers

Always ensure that the mains supply is disconnected before removing any instrument cover plates.
The instrument is protected by three covers: a front panel protection cover, a wrap-around cover with carrying handle, and a rear panel.
To facilitate removal of the wrap-around cover and the rear panel, first ensure that the front cover is in position.

Then proceed as follows:

- Hinge the carrying handle clear of the front cover; to this end, push both pivot centre buttons (Fig. 2.6.).
- Stand the instrument on its protective front cover on a flat surface.
- Slacken the two coin-slot screws located on the rear panel.
- Lift the rear panel and unplug the connector on the power supply board.
- Lift off the wrap-around cover.
- For access to the front-panel, stand the instrument horizontally and snap off the front cover.

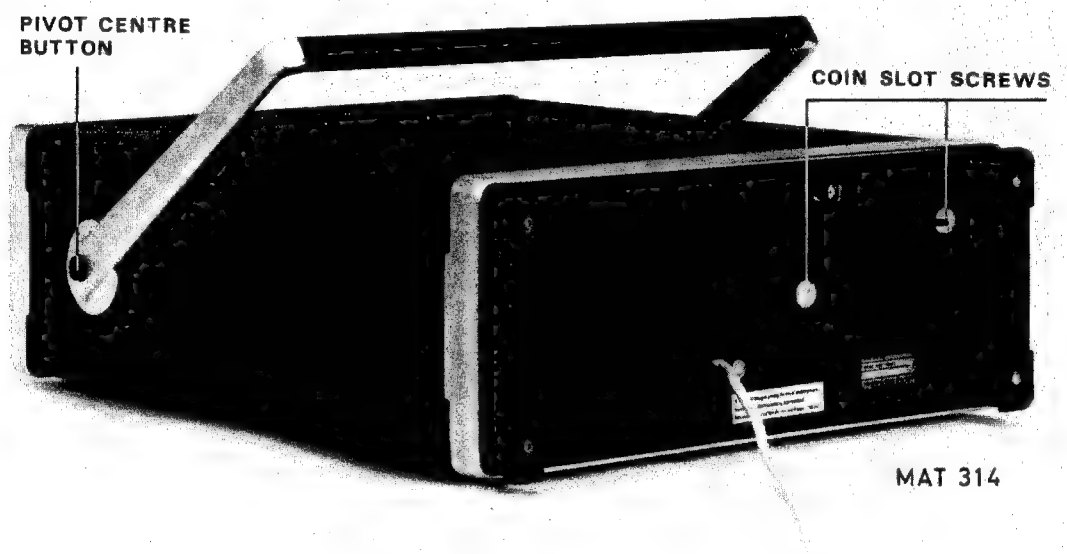


Fig. 2.6. Removing the instrument covers

2.4.2. Removing the mains transformer

- Remove wrap-around cover and rear panel (section 2.4.1.).
- Take the lid off the voltage adapter compartment after removing the 4 cross-slotted screws.
- Remove the 4 cross-slotted screws that hold the lid of the transformer compartment.
- Lift the lid with the attached transformer, simultaneously sliding the wire form between transformer and voltage adapter out of the slit in the transformer compartment.
- The transformer and thermal fuse are then accessible for replacement.

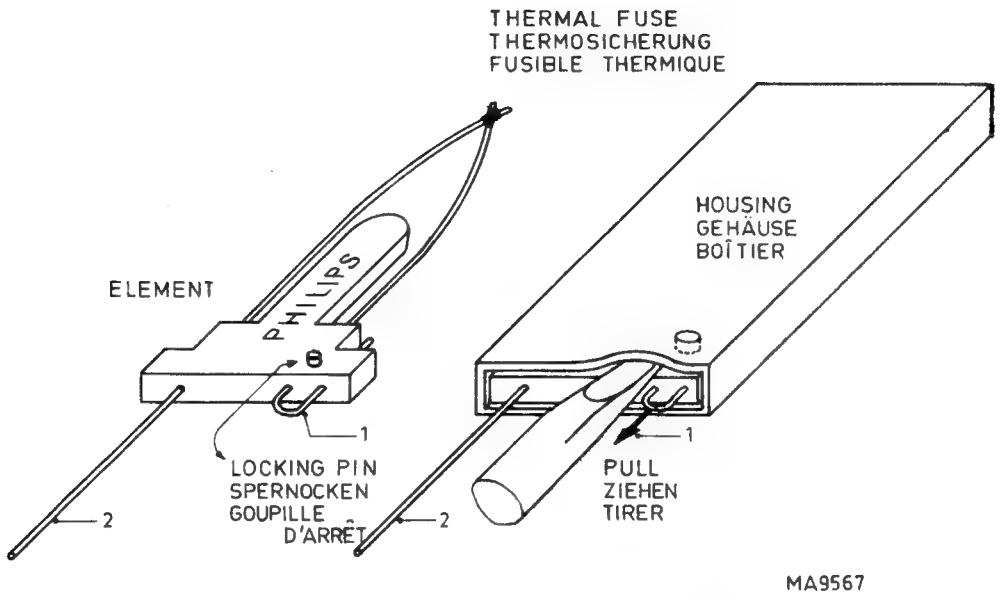


Fig. 2.7. Replacing the thermal fuse

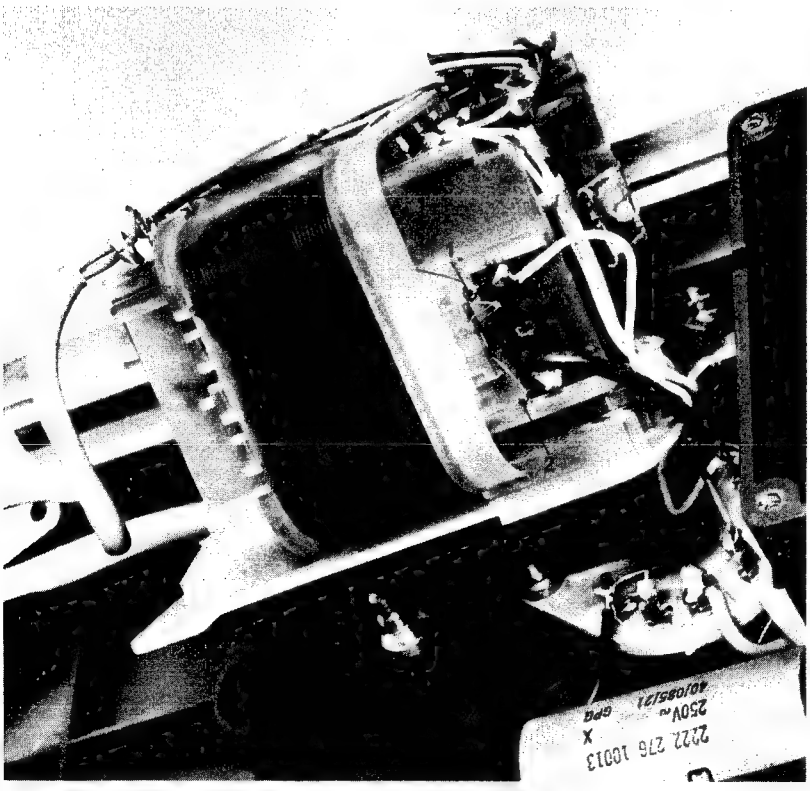


Fig. 2.8. Replacing the thermal fuse

2.4.3. Replacing the thermal fuse F101

- Remove the mains transformer (section 2.4.2.).
- Unsolder fuse terminals 1 and 2 (Fig. 2.7. and 2.8.).
- Only the fuse wire of the old fuse is replaced and not the complete fuse; to this end, bend the housing of the fuse slightly outwards, disengage the locking pin and pull out the wire.
- Take the new fuse and remove the fuse wire out of its housing in the same way as described above.
- Push the new fuse wire into the housing of the old one until the locking pin snaps into the hole. The loop in the fuse wire must point to terminal 1.
- Solder the fuse wire to terminals 1 and 2.

2.4.4. Replacing the fuse F201

- Remove wrap-around cover and rear panel (section 2.4.1.).
- Fuse F201, which is located on the power supply printed circuit board, is now accessible for replacement.

2.4.5. Removing the bezel and the contrast plate

- Take hold of the bezel's bottom corners and gently pull it from the front panel (Fig. 2.9.).
- The contrast filter can be removed by pressing it gently out of the bezel.

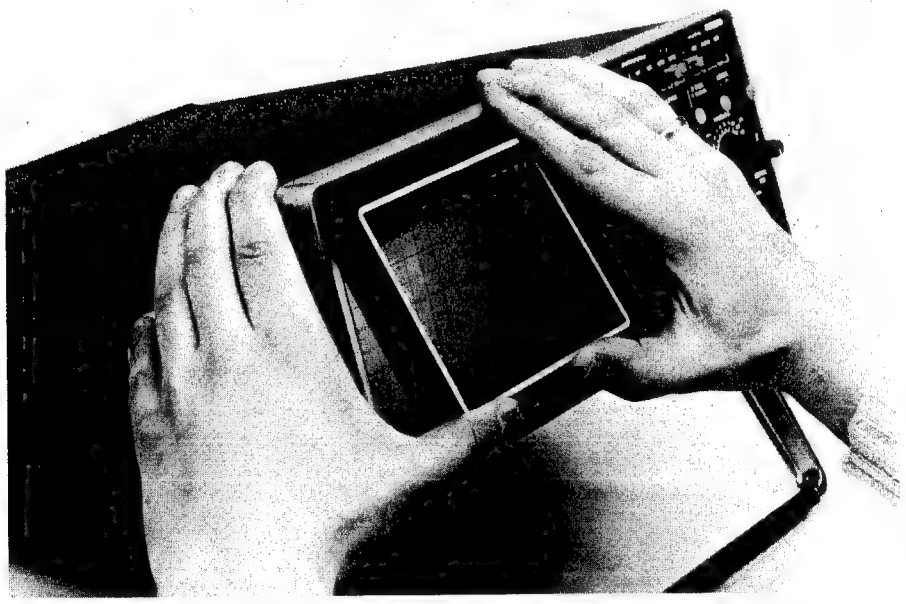


Fig. 2.9. Removing the bezel and the contrast plate

3.3. INFORMATION FOR ASSISTENCE IN FAULT FINDING

3.3.1. Mains transformer data

The available unloaded voltage tappings and the number of turns per winding are listed in the circuit diagram (Fig. 3.44) in the form of a table.

3.3.2. Voltages and waveforms in the instrument

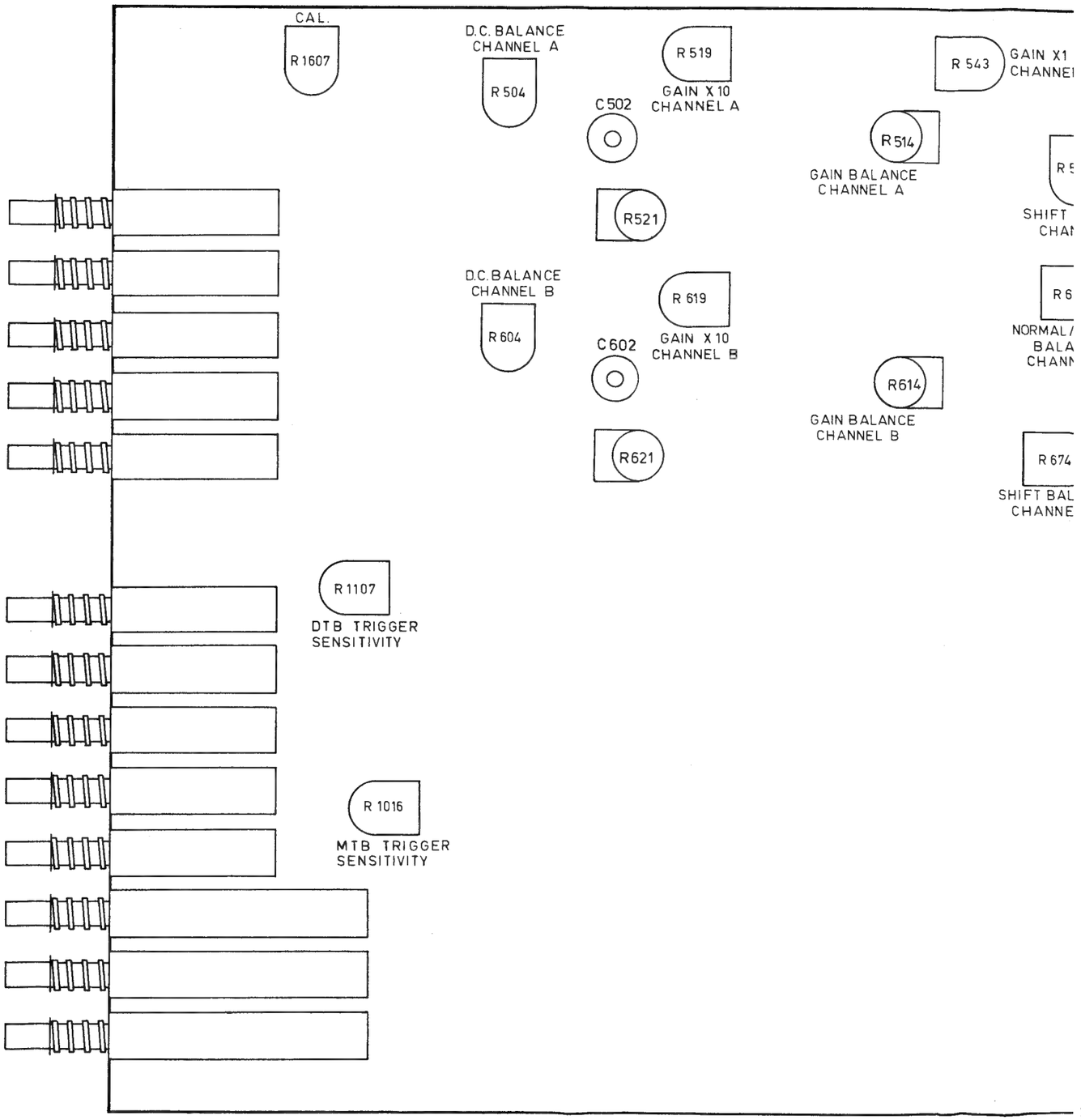
The d.c. voltage levels at the electrodes of the transistors and the voltage waveforms in the time-base generators are shown at the relevant points on the circuit diagrams (Fig. 3.44, Fig. 3.45 and Fig. 3.46). The oscilloscope under test must be set in the following way to measure the voltage wave forms as shown in Fig. 3.44 and Fig. 3.46.

- Display mode switch S1 to position "A".
- X deflection selector switch S3 to position "MTB".
- MTB trigger mode switch S4 to position "AUTO".
- A POSITION potentiometer R2 at mid-range.
- A AMPL/DIV switch S9 to 1 V/div. and potentiometer R9 to CAL.
- Input signal on A input socket X2: 2,5 kHz sine-wave voltage for 8 div. deflection.
- X POSITION potentiometer R6 at mid-range.
- X MAGN switch S7 to position "X1".
- MTB LEVEL potentiometer R7 at mid-range.
- DTB LEVEL potentiometer R5 at mid-range.
- MTB SLOPE switch S8 in position "+".
- DTB SLOPE switch S6 in position "+".
- MTB TRIGGER source selector switch S22 to position "A".
- DTB TRIGGER source selector switch S21 to position "A".
- MTB TIME/DIV switch S15 to 0,2 ms/div. and potentiometer R12 to CAL.
- DTB TIME/DIV switch S13 to OFF for measuring the diagrams 1-2-3-4-5-6-7-8-9-10-13-14-18a-18b-18d-19a en 19b.
- DTB TIME/DIV switch S13 to 50 μs/div. for measuring the diagrams 11-12-15-16-17-18c-18e and 19c.

3.3.3. Remark

In case of a defect it is always possible to apply to the world wide PHILIPS Service Organization.
When the instrument is to be sent to a PHILIPS Service Workshop for repair, the following points should be observed:

- Attach a label with your name and address to the instrument.
- Give a complete description of the faults found, or the service required.
- Use the original packing, or, if this is no longer available, carefully pack the instrument in a wooden crate or box.
- Send the instrument to the address obtained after consultation with the local PHILIPS Organization.



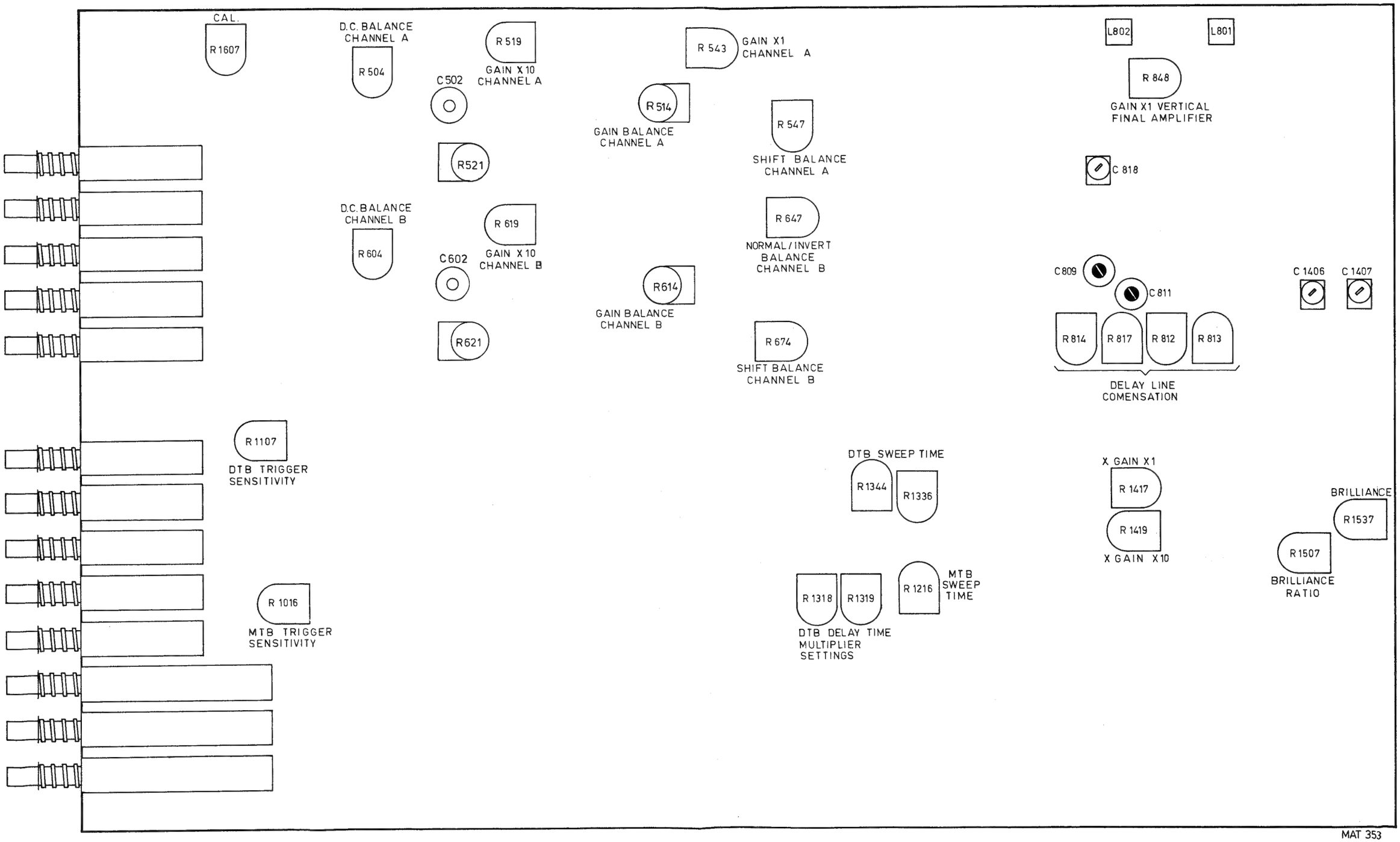


Fig. 3.19. Adjusting elements amplifier board

3.4.

3.4.1.

3.4.2.

3.4. DISMANTLING THE INSTRUMENT

3.4.1. General information

This section provides the dismantling procedures required for the removal of components during repair and routine maintenance operations. All circuit boards removed from the oscilloscope should be adequately protected against damage, and all normal precautions regarding the use of tools must be observed.
During dismantling procedures, a careful note of all leads disconnected must be made so that they may be reconnected to their correct terminals during assembly.

Always ensure that the mains supply is disconnected before removing any instrument cover plates.

Damage may result if the instrument is switched on when a circuit board has been removed, or if a circuit board is removed within one minute of switching off the instrument.

3.4.2. Removing the instrument covers

The instrument is protected by three covers: a front panel protection cover, a wrap-around cover with carrying handle, and a rear panel.
To facilitate removal of the wrap-around cover and the rear panel, first ensure that the front cover is in position.

Then proceed as follows:

- hinge the carrying handle clear of the front cover; to this end, push both pivot centre buttons (Fig. 3.20).
- stand the instrument on its protective front cover on a flat surface
- slacken the two coin-slot screws located on the rear panel
- lift the rear panel and unplug the connector on the power supply board
- lift off the wrap-around cover
- for access to the front-panel, stand the instrument horizontally and snap off the front cover.

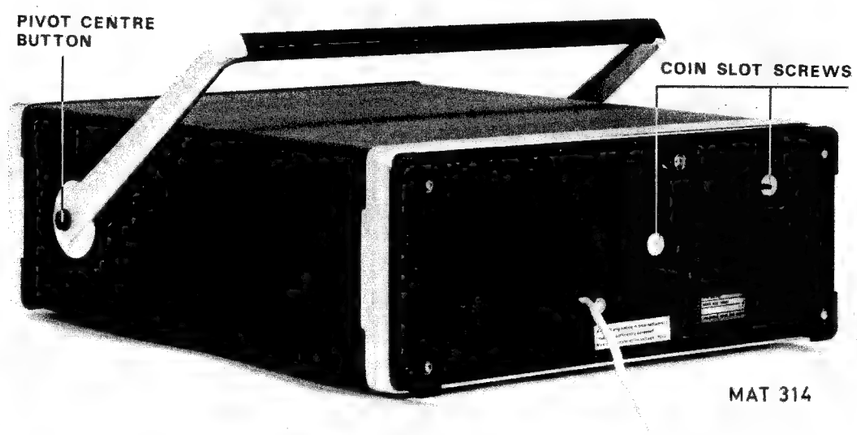


Fig. 3.20. Removing the instrument covers.

Item	Grid loc.
C101	rear panel
C200	power supply
C201	power supply
C202	power supply
C203	power supply
C204	power supply
C206	power supply
C207	power supply
C208	power supply
C209	power supply
C211	power supply
C212	high tension unit
C213	high tension unit
C214	high tension unit
C216	high tension unit
C217	high tension unit
C218	power supply
C219	power supply
C221	power supply
C222	power supply
C223	power supply
C224	power supply
C226	power supply
C227	power supply
C228	power supply
C229	power supply
C231	power supply
C251	C-2
C252	D-2
C253	C-3
C254	D-3
C255	att. unit
C256	att. unit
C257	B-4/B-5
C258	B-3
C259	D-4
C261	E-4
C262	F-5
C263	E-4
C266	B-3
C267	D-4
C268	D-4
C269	C-4
C271	C-4
C272	D-4
C273	C-2/C-3
C274	B-3
C276	D-3
C277	att. unit
C278	B-4/B-5
C279	B-3
C280	att. unit
C281	D-4
C282	D-4
C283	F-4
C284	G-2

Item	Grid loc.
C285	D-3
C286	G-3
C301	att. unit
C305	att. unit
C307	att. unit
C308	att. unit
C309	att. unit
C310	att. unit
C311	att. unit
C312	att. unit
C313	att. unit
C314	att. unit
C315	att. unit
C316	att. unit
C317	att. unit
C318	att. unit
C319	att. unit
C320	att. unit
C321	att. unit
C322	att. unit
C324	att. unit
C351	att. unit
C352	att. unit
C353	att. unit
C356	att. unit
C401	att. unit
C405	att. unit
C407	att. unit
C408	att. unit
C409	att. unit
C410	att. unit
C411	att. unit
C412	att. unit
C413	att. unit
C414	att. unit
C415	att. unit
C416	att. unit
C417	att. unit
C418	att. unit
C419	att. unit
C420	att. unit
C421	att. unit
C422	att. unit
C424	att. unit
C451	att. unit
C452	att. unit
C453	att. unit
C501	C-2
C502	C-2
C503	C-2
C504	D-2
C507	D-2
C509	E-2
C511	D-2
C513	E-2

Item	Grid loc.
C517	E-2
C518	E-2
C519	E-2
C520	C-2
C521	E-2
C522	F-2
C523	C-2
C601	C-3
C602	C-3
C603	C-3
C604	D-3
C607	D-3
C609	E-2
C611	D-3
C613	E-3
C616	E-3
C617	E-3
C618	E-3
C619	F-3
C620	C-3
C621	E-3
C622	F-3
C623	C-3
C701	E-3
C702	E-2
C703	E-3
C704	E-3
C705	E-2
C706	E-2
C707	F-2
C801	F-3
C802	F-3
C803	F-3
C804	F-3
C805	G-2
C806	F-3
C807	F-3
C808	F-3
C809	F-3
C810	F-2
C811	F-3
C812	G-3
C813	G-3
C814	G-2
C815	G-3
C816	F-2
C817	F-2
C818	F-2
C821	F-2
C1001	B-5
C1002	C-4
C1003	C-4
C1004	B-5
C1005	C-4/D-4
C1006	C-4

Item	Grid loc.
C1007	C-5
C1008	C-5/D-5
C1009	C-5
C1011	C-5
C1012	C-5
C1101	B-4
C1102	B-4
C1103	C-4
C1104	C-4
C1201	D-5
C1202	E-5
C1203	D-5
C1204	D-5
C1205	D-5
C1206	E-5
C1207	D-4
C1208	E-5
C1209	E-5
C1210	E-4
C1301	E-5
C1302	D-4
C1303	D-4
C1304	E-4
C1305	E-5
C1306	E-4
C1307	D-5/E-5
C1308	E-5
C1309	D-5
C1310	D-4
C1311	D-5
C1321	D-4
C1314	E-4
C1315	D-4
C1316	D-4
C1402	F-5
C1404	G-3
C1405	G-3
C1406	G-3
C1407	G-3
C1408	G-3
C1409	G-2
C1411	G-3
C1412	G-2
C1413	G-2/G-3
C1414	G-2/G-3
C1416	G-2
C1417	G-2
C1501	G-5
C1502	G-5
C1503	G-5
C1504	G-5
C1506	G-4
C1507	G-5
C1508	G-5

Item	Grid loc.
C1509	G-4
C1511	G-5
C1512	on tube
C1601	B-2
C1602	B-2
C1651	F-4
C1652	F-4
C1653	F-5
C1654	F-5
C1655	F-4
C1656	F-5
C1657	F-5
C1658	F-5
C1659	F-5
C1660	E-3
R1	front panel
R2	front panel
R3	front panel
R4	front panel
R5	front panel
R6	front panel
R7	front panel
R8	front panel
R9	front panel
R10	front panel
R11	front panel
R12	front panel
R13	front panel
R14	front panel
R15	front panel
R200	power supply
R201	power supply
R202	power supply
R203	power supply
R204	power supply
R206	power supply
R207	power supply
R208	power supply
R209	power supply
R210	power supply
R211	high t.u.
R212	power supply
R227	B-3/C-3
R251	B-2/C-2
R252	B-2/C-2
R253	B-3/C-3
R254	C-3
R256	D-3
R257	att. unit
R258	B-4
R259	B-3
R261	E-3/E-4
R262	F-5
R263	E-3/E-4
R264	B-3
R266	D-4

Item	Grid loc.
R267	C-4
R268	D-4
R269	B-2/C-2
R271	B-3
R272	D-3
R273	att. unit
R274	B-4
R276	C-3
R277	D-4
R278	F-4
R279	G-3
R281	G-3
R302	att. unit
R303	on switch S9
R304	on switch S9
R306	on switch S9
R307	att. unit
R308	att. unit
R309	att. unit
R311	att. unit
R312	att. unit
R313	on switch S9
R314	on switch S9
R316	att. unit
R317	att. unit
R318	att. unit
R319	att. unit
R351	att. unit
R352	att. unit
R353	att. unit
R354	att. unit
R355	att. unit
R356	att. unit
R357	att. unit
R358	att. unit
R359	att. unit
R360	att. unit
R361	att. unit
R362	att. unit
R363	att. unit
R364	att. unit
R365	att. unit
R366	att. unit
R367	att. unit
R368	att. unit
R369	att. unit
R374	att. unit
R402	att. unit
R403	on switch S11
R404	on switch S11
R406	on switch S11
R407	att. unit
R408	att. unit
R409	att. unit
R411	att. unit
R412	att. unit

Item	Grid loc.
R413	on switch S11
R414	on switch S11
R416	att. unit
R417	att. unit
R418	att. unit
R419	att. unit
R451	att. unit
R452	att. unit
R453	att. unit
R454	att. unit
R456	att. unit
R457	att. unit
R458	att. unit
R459	att. unit
R461	att. unit
R462	att. unit
R463	att. unit
R464	att. unit
R466	att. unit
R467	att. unit
R468	att. unit
R469	att. unit
R500	C-2
R501	C-2
R502	C-2
R503	C-2
R504	C-2
R506	C-2
R507	D-2
R508	D-2
R509	D-2
R511	C-2
R512	C-2
R513	C-2
R514	D-2
R516	D-2
R517	C-2/D-2
R518	C-2/D-2
R519	C-2/D-2
R521	D-2
R522	D-2
R523	D-2
R524	D-2
R526	D-2
R527	D-2
R528	D-2
R529	D-2
R531	D-2
R532	D-2
R533	D-2
R534	D-2
R535	D-2
R536	E-2
R537	E-2
R538	D-2/E-2
R539	E-2
R540	D-2
R541	E-2

Item	Grid loc.
R542	D-2
R543	D-2
R546	E-2
R547	E-2
R548	E-2
R549	D-2
R550	E-2
R551	E-2
R552	D-2
R553	D-2
R554	D-2
R558	E-2
R559	E-2
R568	E-2
R569	E-2
R571	F-2
R572	F-2
R573	E-2
R577	F-2
R600	C-3
R601	C-3
R602	C-3
R603	C-3
R604	C-3
R606	C-3
R607	C-3
R608	C-3
R609	C-3
R611	C-3
R612	C-3
R613	C-3
R614	D-3
R616	D-3
R617	C-3/D-3
R618	C-3/D-3
R619	C-3/D-3
R621	C-3
R622	D-3
R623	D-3
R624	D-3
R626	D-3
R627	D-3
R628	D-3
R629	D-3
R631	D-3
R632	D-3
R633	D-3
R634	D-3
R635	D-3
R636	E-3
R637	D-3/E-3
R638	E-3
R639	D-3/E-3

Item	Grid loc.
R640	D-3
R641	D-3/E-3
R646	E-3
R647	E-3
R648	E-3
R649	D-3
R650	E-2
R651	E-3
R652	D-3
R653	D-3
R654	D-3
R658	E-3
R659	E-3
R661	E-3
R662	E-3
R663	E-3
R664	E-3
R668	E-3
R669	E-3
R671	E-3/F-3
R672	E-3/F-3
R673	E-3
R674	E-3
R676	E-3
R677	F-3
R701	E-2/E-2
R702	E-3
R703	E-2
R704	E-2
R706	E-3
R707	E-2/E-3
R708	E-2/E-3
R709	F-2
R711	F-3
R712	F-2
R713	E-3
R714	E-2
R716	F-3
R717	F-3
R801	F-2
R802	F-3
R803	F-3
R804	F-2
R806	F-3
R807	F-3
R809	F-2/F-3
R811	F-3
R812	F-3
R813	G-3
R814	F-3
R816	F-3
R817	F-3
R818	F-2
R819	F-3

Item	Grid loc.
R821	F-3
R822	F-3/G-3
R823	G-3
R824	G-3
R825	G-3
R826	G-3
R827	G-3
R828	G-3
R829	F-3
R831	F-2
R832	F-2
R833	G-3
R837	F-3
R838	G-2
R839	F-2
R843	F-2
R847	F-2
R848	F-2
R849	F-2
R851	G-2
R852	F-2
R853	F-2
R854	F-2
R856	F-2
R857	F-2
R858	F-2
R859	F-2/G-2
R861	F-2
R862	F-2/G-2
R863	F-2
R864	G-2
R866	F-2/F-3
R1001	B-5
R1002	C-4
R1003	C-4
R1004	C-4
R1006	C-4
R1007	C-5
R1008	C-5
R1009	C-5
R1011	C-5
R1012	B-4
R1013	B-5
R1014	C-5
R1016	B-4
R1017	C-5
R1018	C-4
R1019	C-5
R1021	C-5
R1022	C-4
R1023	C-4
R1024	C-4

Item	Grid loc.
R1026	C-5
R1027	C-5
R1028	C-5
R1029	C-4
R1031	C-4
R1032	C-4
R1034	C-4
R1036	C-4
R1037	C-5
R1038	C-4
R1039	C-4
R1041	C-4
R1042	C-5
R1043	C-5
R1044	C-5
R1046	C-5
R1047	C-5
R1048	C-5
R1049	C-5
R1051	C-5
R1052	C-5
R1101	B-4
R1102	C-4
R1103	B-4
R1104	B-4
R1106	B-4
R1107	B-4
R1108	B-4
R1109	C-4
R1111	C-4
R1112	C-4
R1113	C-4
R1114	C-4
R1116	C-4
R1117	C-4
R1118	C-4
R1119	C-4
R1121	C-4
R1122	C-4
R1123	C-4
R1124	C-4
R1201	D-5
R1202	D-5
R1203	D-4
R1204	D-4
R1205	D-5
R1206	D-5
R1207	D-5
R1208	D-5
R1209	G-4
R1210	D-5
R1211	E-5
R1212	E-5
R1213	E-4
R1214	E-4
R1216	E-4
R1217	D-5

Item	Grid loc.
R1218	D-5
R1219	E-5
R1221	D-5
R1222	E-5
R1223	D-5
R1224	D-5
R1226	D-5
R1227	E-4
R1276	on switch S15
R1277	
R1278	
R1279	
R1281	
R1282	
R1283	
R1284	
R1286	
R1287	
R1288	
R1289	
R1291	
R1301	E-5
R1302	E-4
R1303	E-5
R1304	E-5
R1305	E-4
R1306	E-5
R1307	E-5
R1308	E-5
R1309	E-5
R1311	E-5
R1312	E-5
R1313	D-4
R1314	E-5
R1316	E-4
R1317	E-5
R1318	E-4
R1319	E-4
R1321	D-4
R1322	E-4
R1324	D-4
R1326	D-4
R1327	E-4
R1328	D-4
R1329	E-4
R1330	D-4/E-4
R1331	E-4
R1332	E-4
R1333	E-4
R1334	E-4
R1336	E-4
R1337	E-4
R1338	E-4
R1339	E-4
R1340	E-4
R1341	E-4
R1342	E-4
R1343	E-4

Item	Grid loc.
R1344	E-4
R1346	E-4
R1347	D-4
R1376	on switch S13
R1377	
R1378	
R1379	
R1381	
R1382	
R1383	
R1401	F-4
R1402	F-4
R1403	F-4
R1404	F-5
R1406	F-4/F-5
R1407	F-5
R1408	F-5
R1409	F-5
R1411	F-5
R1412	F-5
R1413	F-5
R1414	F-4
R1416	F-4
R1417	F-4
R1418	F-4
R1419	F-4
R1421	F-4
R1422	F-4
R1423	F-4
R1424	F-5
R1425	G-3
R1426	G-3
R1427	G-3
R1428	G-2
R1429	G-3
R1431	G-3
R1432	G-3
R1433	G-3
R1434	G-3
R1436	G-2
R1437	G-3
R1438	G-4
R1439	G-3
R1441	G-2
R1442	G-2
R1443	G-3
R1444	G-3
R1446	G-2
R1447	G-2
R1448	on R6
R1449	
R1451	
R1501	F-4
R1502	G-4
R1503	G-4
R1504	G-4

Item	Grid loc.
R1506	F-5
R1507	G-4
R1508	G-4
R1509	G-4
R1511	G-4
R1512	G-4
R1513	G-5
R1514	G-5
R1516	G-5
R1517	G-5
R1518	G-5
R1519	G-4
R1521	G-5
R1522	G-4
R1524	G-4
R1526	G-4
R1527	G-4
R1528	G-5
R1529	G-4
R1531	G-5
R1532	G-4
R1533	G-4
R1534	G-5
R1535	on tube
R1536	G-4
R1537	G-4
R1538	power supply
R1539	power supply
R1541	power supply
R1542	power supply
R1543	power supply
R1544	power supply
R1546	power supply
R1547	power supply
R1548	power supply
R1549	power supply
R1551	power supply
R1552	on tube
R1553	G-5
R1601	B-2
R1602	B-2
R1603	B-2
R1604	B-2
R1606	B-2
R1607	B-2
R1608	B-2
R1609	B-2
R1611	B-2
R1612	B-2
R1613	B-2
R1614	B-2
R1616	B-2
R1617	B-2
R1618	B-2
R1619	B-2
R1651	F-5

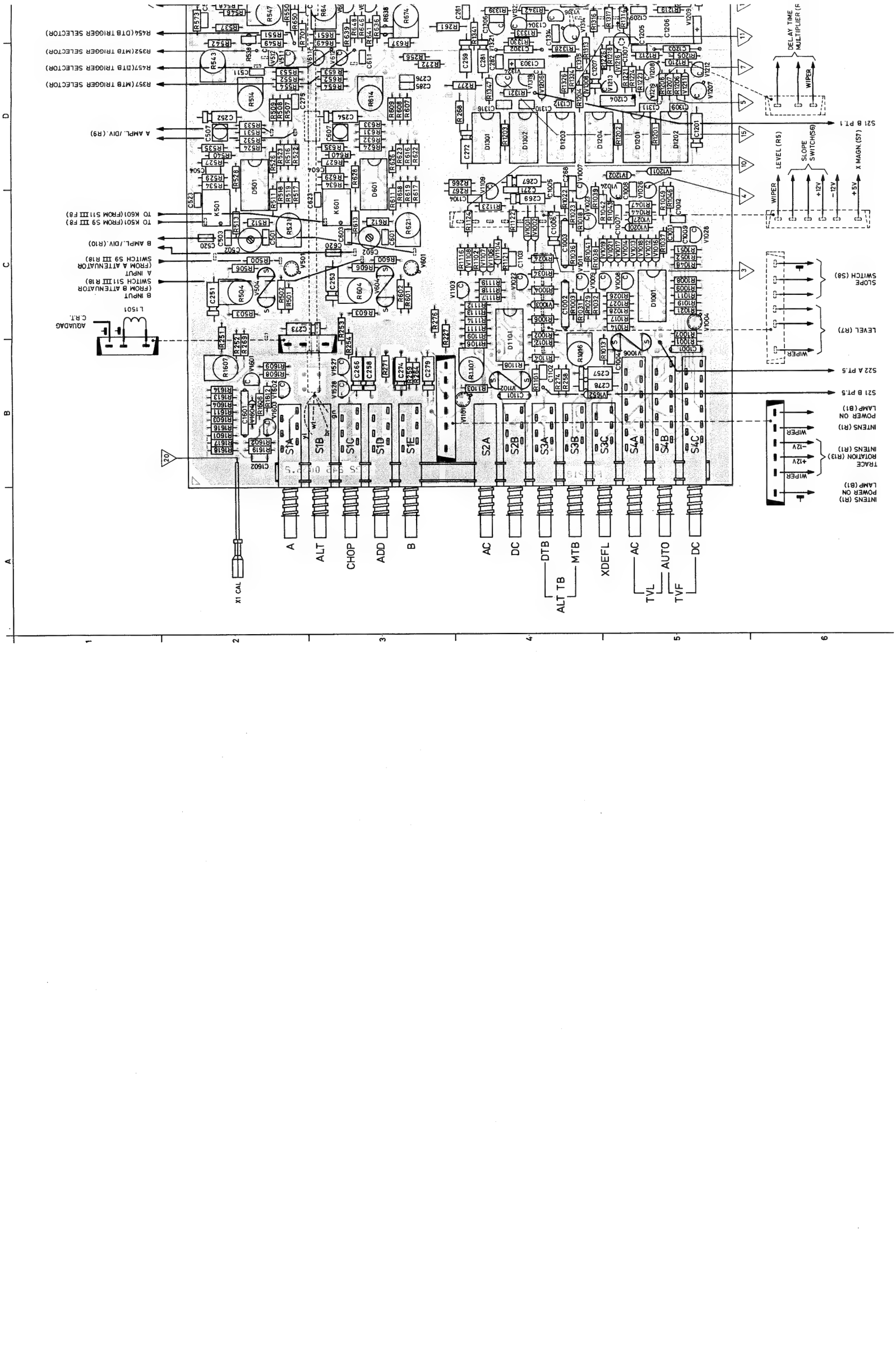
Item	Grid loc.
R1652	F-5
R1653	F-5
R1654	F-5
R1656	F-5
R1657	F-5
R1658	F-5
R1659	F-5
R1661	F-5
R1662	F-5
R1663	F-5
R1664	F-4
R1666	F-4
R1667	F-4
R1668	F-4
R1669	F-5
R1671	F-4
R1672	F-4
R1673	E-4
R1674	F-4
R1676	F-5
R1677	F-4
R1678	F-4
R1679	F-5
R1681	F-5
R1682	F-5
R1683	F-4
R1684	F-4
R1686	F-4
R1687	F-4
R1688	F-4
V1	tube
V201	power supply
V202	power supply
V203	power supply
V204	power supply
V206	power supply
V207	power supply
V208	power supply
V209	power supply
V211	power supply
V212	power supply
V213	power supply
V214	power supply
V216	power supply
V217	power supply
V218	power supply
V219	power supply
V221	power supply
V222	power supply
V223	power supply
V224	power supply
V226	high tension unit
V227	
V228	
V229	
V231	

Item	Grid loc.
V232	power supply
V233	power supply
V234	power supply
V236	power supply
V237	power supply
V238	power supply
V239	power supply
V241	power supply
V242	power supply
V243	power supply
V244	power supply
V246	power supply
V247	power supply
V351	att. unit
V352	att. unit
V353	att. unit
V354	att. unit
V451	att. unit
V452	att. unit
V453	att. unit
V501	C-2
V504	C-2
V508	E-2
V509	E-2
V511	D-2
V512	D-2
V513	E-2
V514	E-2
V518	E-2
V519	E-2
V521	F-2
V522	F-2
V523	F-2
V524	F-2
V526	F-2
V601	C-3
V604	C-3
V608	E-3
V609	E-3
V611	D-3
V612	D-3
V613	E-3
V614	E-3
V616	E-3
V617	E-3
V618	E-3
V619	E-3
V621	F-3
V622	F-3
V623	F-3
V624	F-3
V626	F-3

Item	Grid loc.
V701	E-2
V702	E-3
V703	E-2
V704	E-3
V801	F-2/F-3
V802	F-3
V803	F-3
V804	G-2
V806	G-2
V807	F-2
V808	F-2
V809	F-2
V1001	C-4
V1002	C-4
V1003	C-4
V1004	C-5
V1006	B-5
V1007	C-4/D-4
V1008	C-5
V1009	C-5
V1011	C-4
V1012	C-5
V1013	C-5
V1014	C-5
V1016	C-5
V1017	C-5
V1018	C-5
V1019	C-5
V1020	C-5
V1021	C-5
V1022	C-4
V1023	C-4
V1024	C-5/D-5
V1026	C-5/D-5
V1027	C-5
V1028	C-5
V1101	B-4
V1102	B-4
V1103	C-4
V1104	C-4
V1106	C-4
V1107	C-4
V1108	C-4
V1109	C-4/D-4
V1201	D-5
V1202	D-5
V1206	D-4
V1207	D-5
V1208	D-5
V1209	E-5
V1211	D-5
V1212	D-5
V1213	D-5
V1214	E-4
V1216	D-5
V1217	E-4

Item	Grid loc.
V1218	E-5
V1219	D-5
V1221	E-5
V1301	E-4/E-5
V1302	E-5
V1303	E-5
V1304	E-5
V1305	E-5
V1306	E-5
V1307	E-5
V1308	D-4
V1314	E-4
V1316	E-4
V1318	E-4
V1319	D-4
V1321	E-4
V1322	E-4
V1323	E-4
V1324	D-4
V1326	E-4
V1401	E-4
V1402	F-5
V1403	F-5
V1404	F-4
V1406	F-4
V1407	F-4
V1408	F-5
V1409	F-5
V1411	F-5
V1412	F-4/F-5
V1413	F-4
V1414	F-4
V1416	G-2
V1417	G-2
V1418	G-3
V1419	G-3
V1421	G-3
V1422	G-3
V1423	G-3
V1424	G-2
V1426	G-3
V1427	G-2
V1428	G-2
V1429	G-2
V1431	G-2
V1501	G-4
V1502	G-4
V1503	G-4
V1504	G-4
V1506	G-4
V1507	G-4
V1508	G-4
V1509	G-4
V1511	G-4
V1512	G-4
V1514	G-4

Item	Grid loc.
V1516	G-4
V1517	G-4
V1518	G-5
V1519	G-5
V1521	G-4
V1522	G-4/G-5
V1523	G-4/G-5
V1524	G-4
V1526	G-5
V1527	B-2
V1528	B-2
V1601	B-2
V1602	B-2
V1603	B-2
V1604	B-2
V1651	F-5
V1652	B-4/B-5
V1653	F-5
V1654	F-5
V1655	F-5
V1656	F-5
V1657	F-5
V1658	F-5
V1659	F-5
V1661	F-4
V1662	E-4
V1663	F-4/F-5
V1664	E-4/F-4
V1666	F-4
V1667	F-4/F-5
V1668	F-4
D501	C-2/D-2
D601	C-3/D-3
D801	F-3
D1001	C-5
D1101	B-4/C-4
D1201	D-5
D1202	D-5
D1203	D-4
D1204	D-4/D-5
D1301	D-4
D1302	D-4
B1	LED
T101	rear panel
T201	power supply
T202	power supply
F201	power supply
K501	C-2
K601	C-3
K1401	F-4
L201	power supply
L202	power supply
L203	power supply
L801	G-2
L802	F-2
L1501	trace rot. coil


A
B
C
D
1
2
3
4
5
6
R454(DTB TRIGGER SELECTOR)
R452(MTB TRIGGER SELECTOR)
R457(DTB TRIGGER SELECTOR)
R457(MTB TRIGGER SELECTOR)
A AMPL./DIV.(R9)
TO K601(FROM S11 III F8)
TO K501(FROM S9 III F8)
B AMPL./DIV.(R10)
A INPUT SWITCH S11 III R18) (FROM A ATTENUATOR
B INPUT SWITCH S11 III R18) (FROM B ATTENUATOR
AQUADAG C.R.T.
L1501
X1 CAL
A
ALT
CHOP
ADD
B
AC
DC
DTB
ALT TB
MTB
XDEFL
AC
TVL
AUTO
TVF
DC
S1A
S1B
S1C
S1D
S1E
S2A
S2B
S3A
S3B
S3C
S4A
S4B
S4C
S21 B PT.1
S22 A PT.5
S21 B PT.5
DELAY TIME MULTIPLIER (R
WIPER
LEVEL (R5)
SLOPE SWITCH(S6)
+12V
-12V
+5V
X MAGN.(S7)
SLOPE SWITCH (S8)
LEVEL (R7)
INTENS (R1)
POWER ON LAMP (B1)
TRACE ROTATION (R13)
+12V
-12V

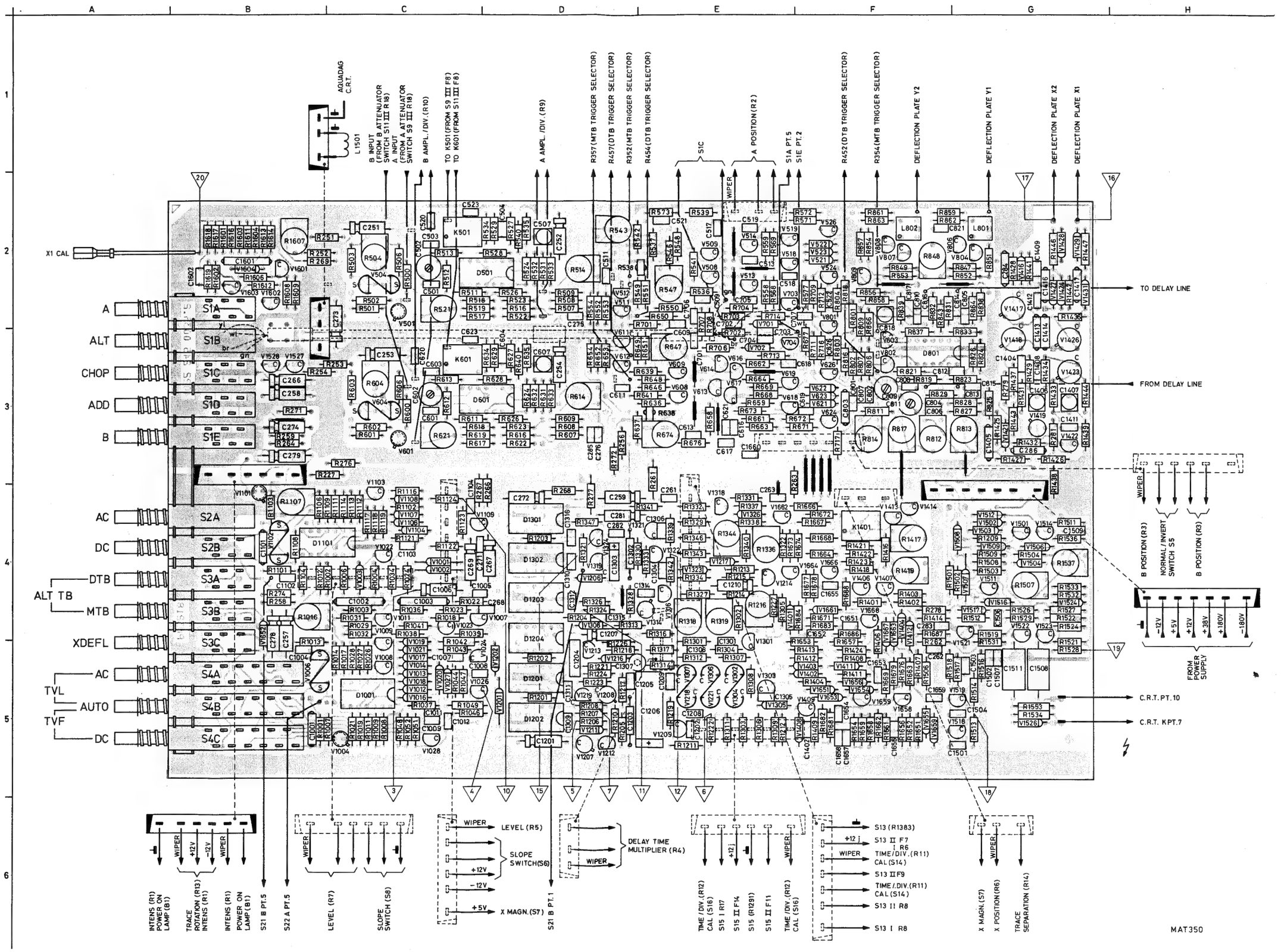


Fig. 3.40. Vertical amplifier unit with rear side tracks

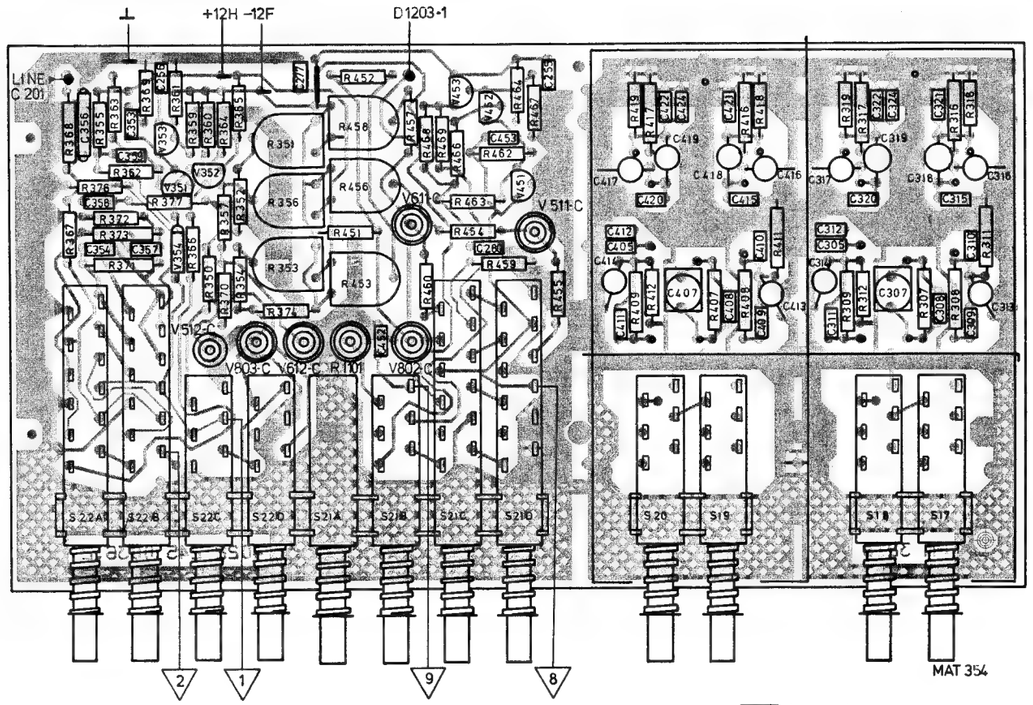


Fig. 3.41. Vertical attenuator unit

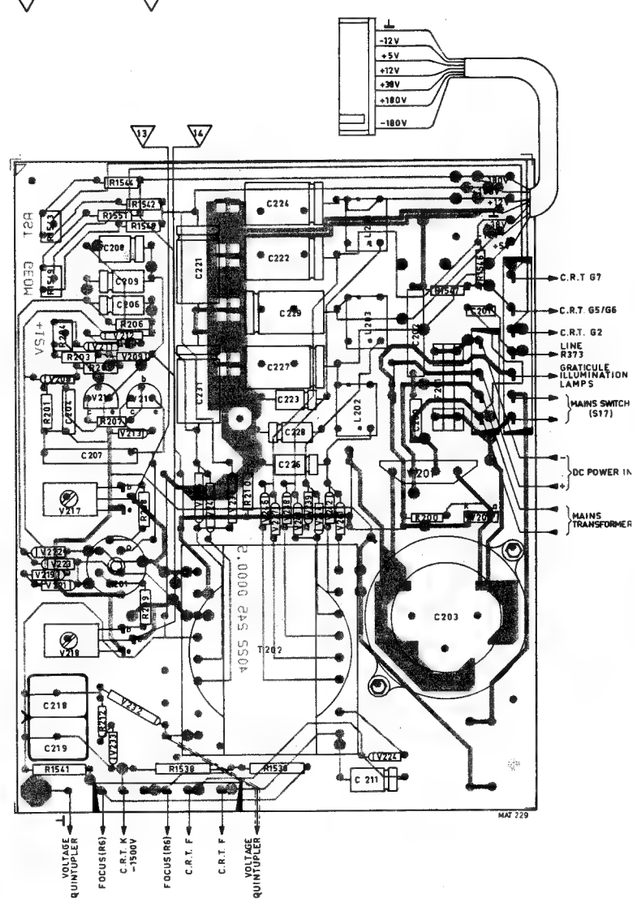


Fig. 3.42. Power supply unit

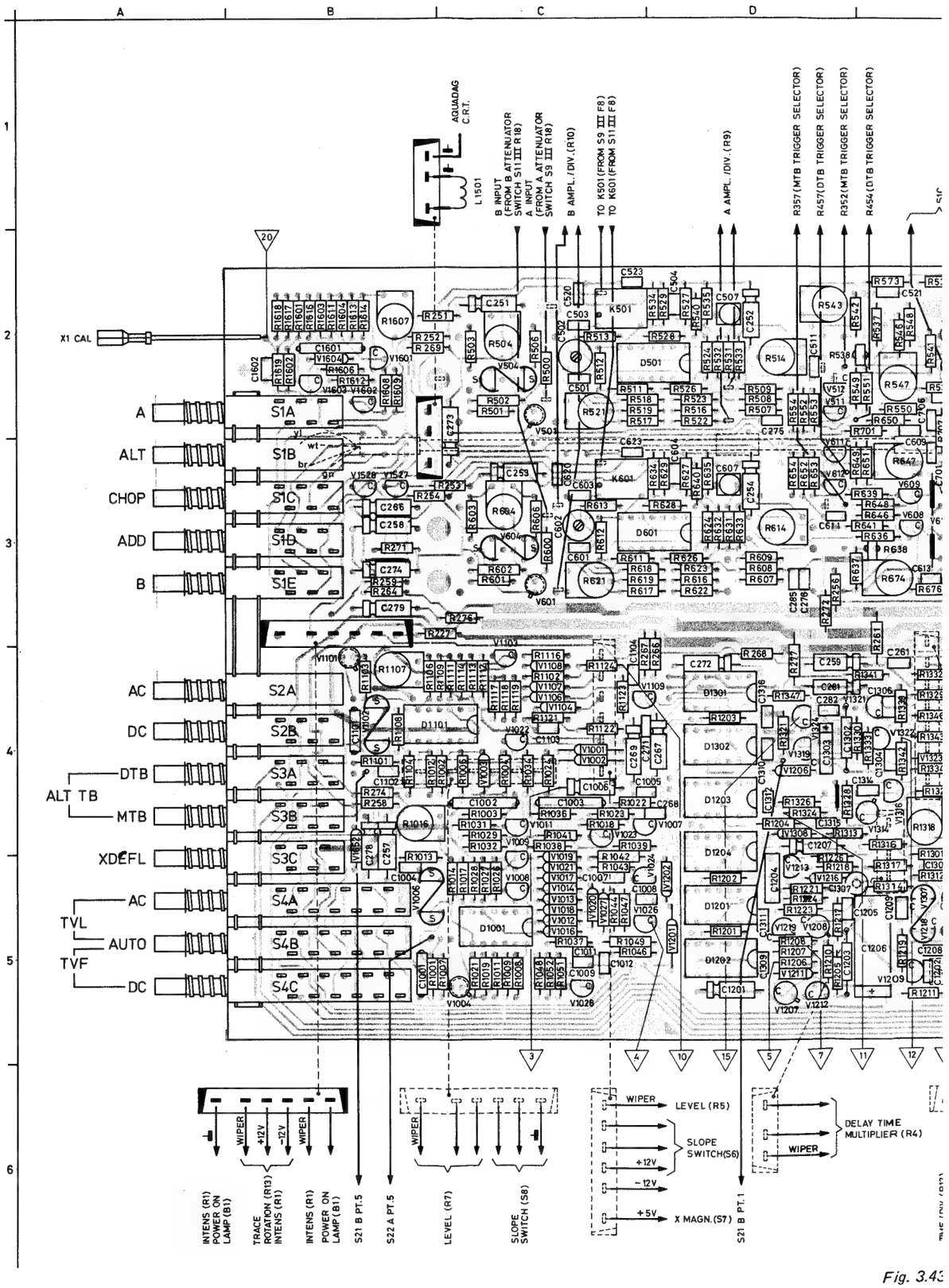


Fig. 3.43

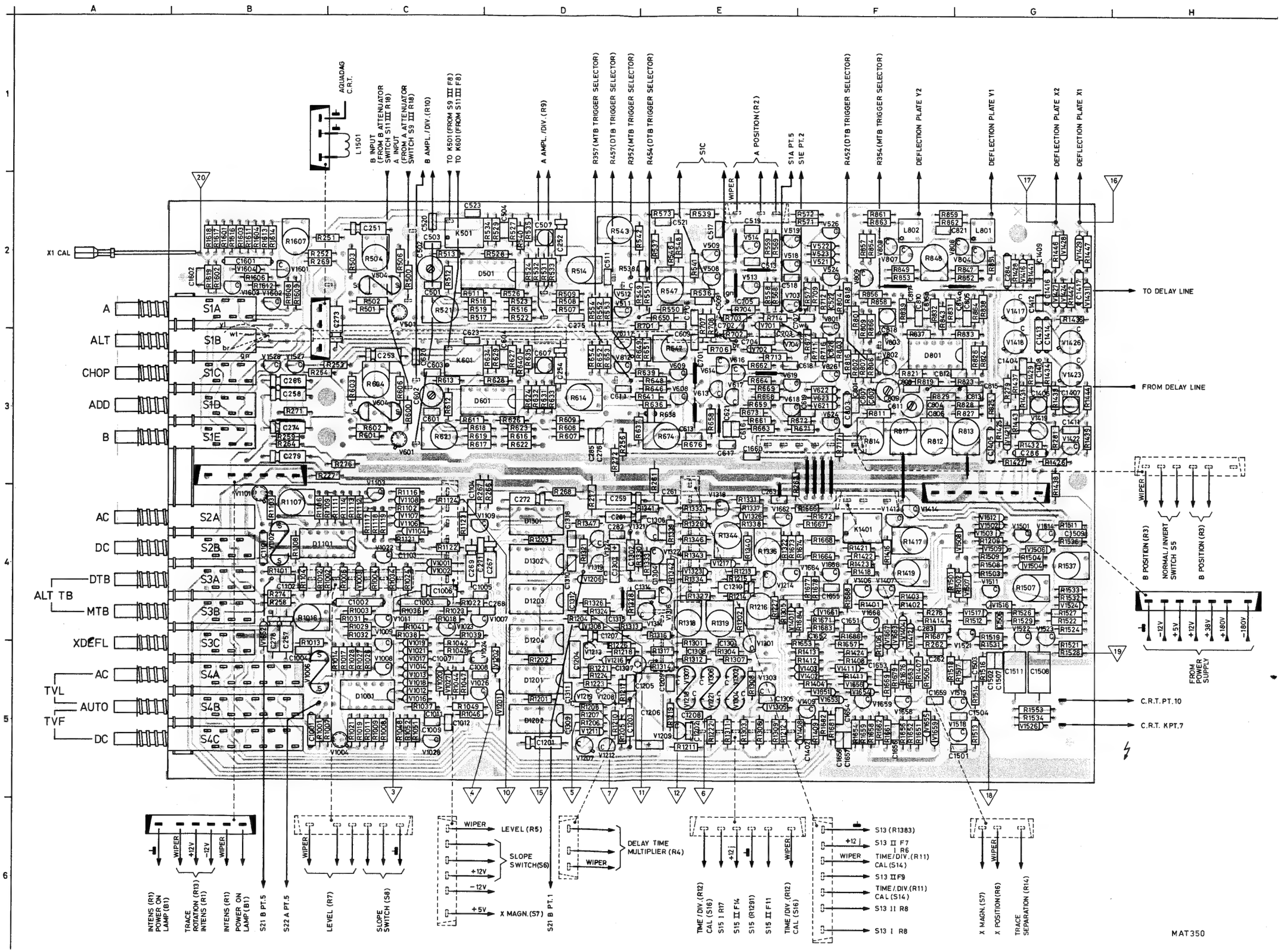
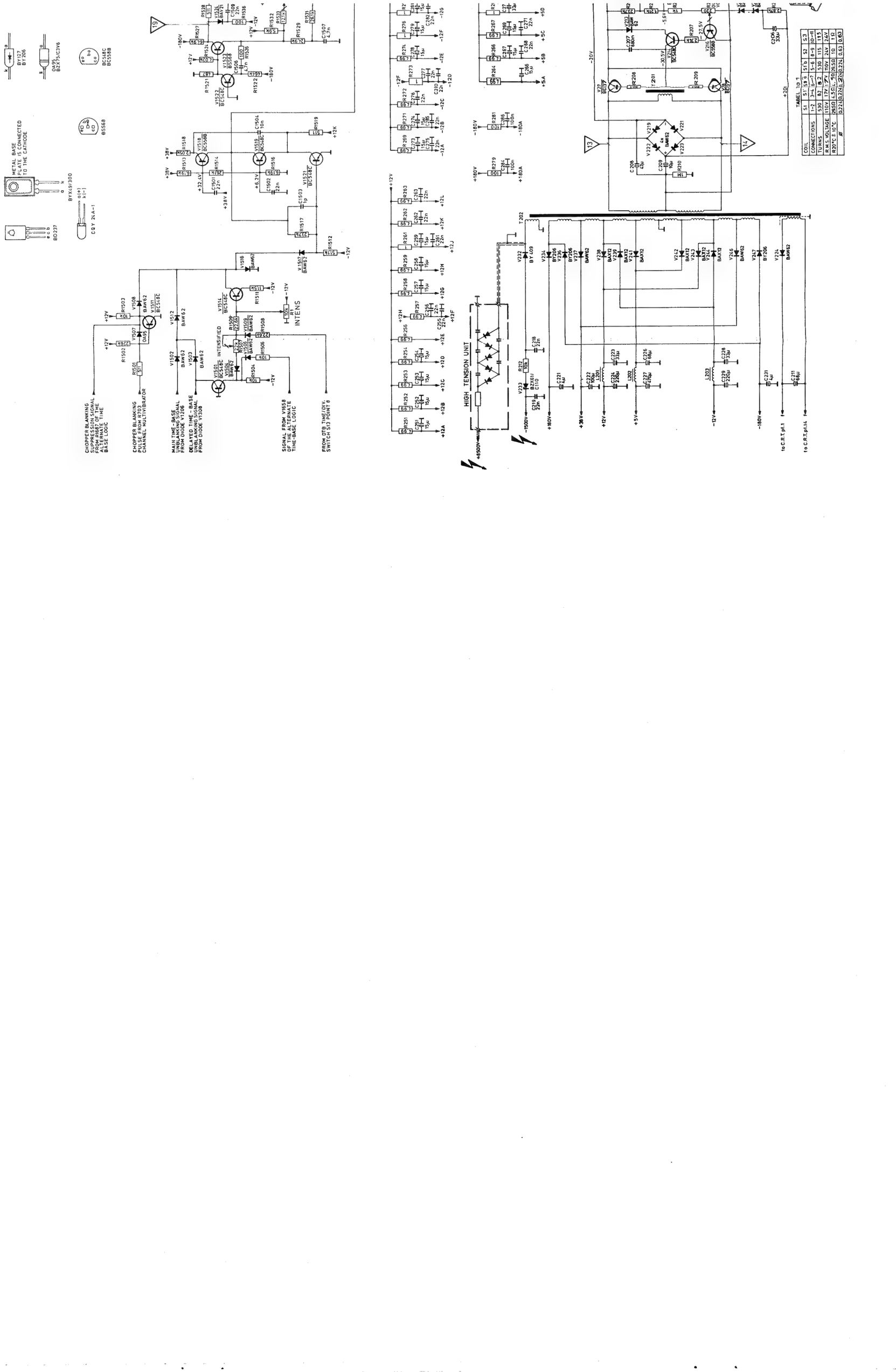
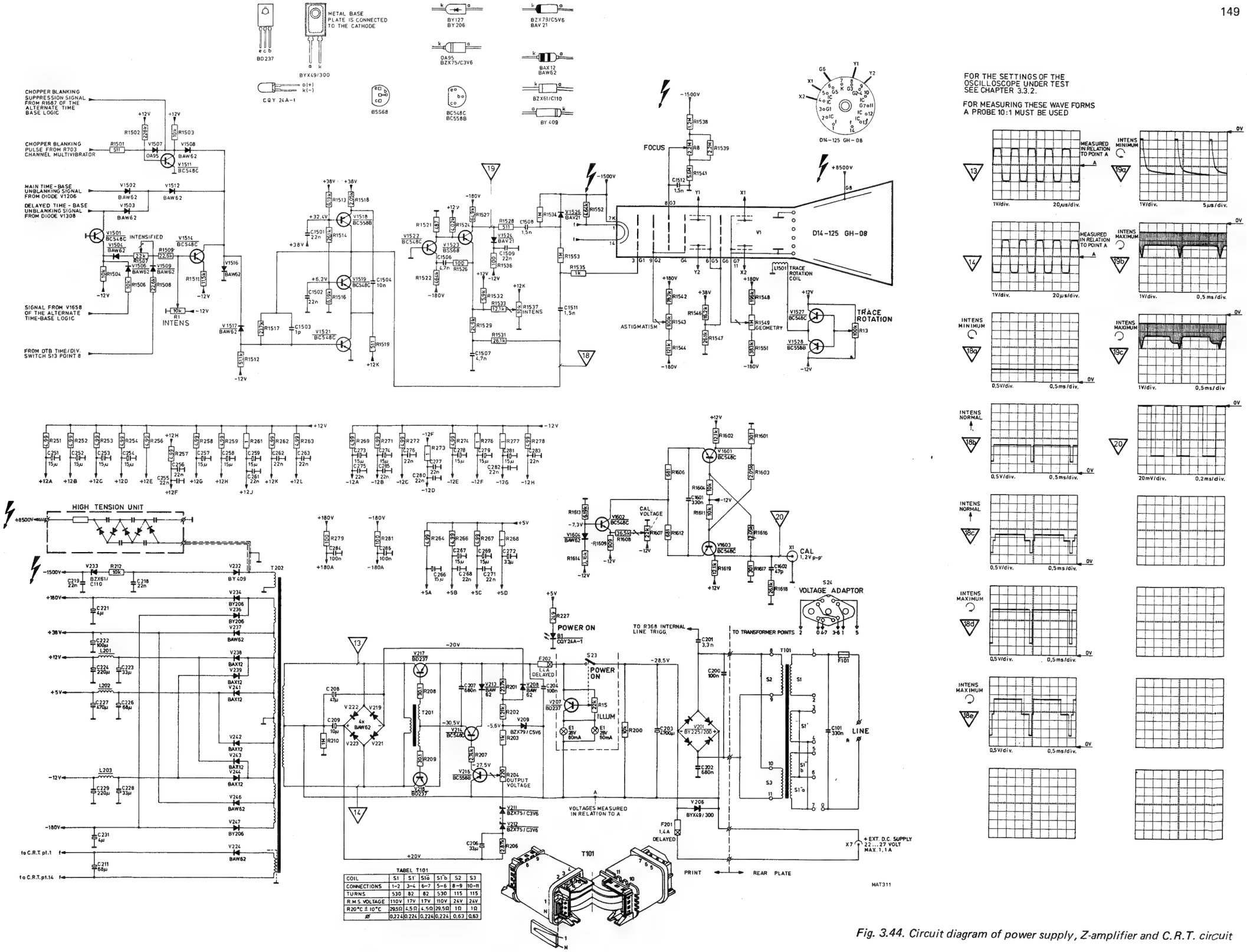


Fig. 3.43. Vertical amplifier unit with upper side tracks


METAL BASE PLATE IS CONNECTED TO THE CATHODE
BY127 BY206
BD237
BYX39/300
CQY 24A-1
BSS68
BC548C BC558B
CHOPPER BLANKING CHANNEL I SIGNAL FROM RR87 OF THE ALTERNATE TIME BASE LOGIC
CHOPPER BLANKING PULSE FROM R703 CHANNEL I MULTIVIBRATOR
MAIN TIME-BASE UNBLANKING SIGNAL FROM DIODE V1208
DELAYED TIME-BASE UNBLANKING SIGNAL FROM DIODE V1308
SIGNAL FROM V1658 OF THE ALTERNATE TIME-BASE LOGIC
FROM DTB TIME/DIV. SWITCH S13 POINT 8
INTENSIFIED
INTENS
HIGH TENSION UNIT
+8500V
-1500V
+180V
+38V
+12V
-12V
-180V
to C.R.T. pl. 1
to C.R.T. pl. 14
TABEL 10.1
COIL
CONNECTIONS
TURNS
R.M.S. VOLTAGE
R20°C ± 10°C
Ø
S1
S1'
S1''
S2
S1'b
S3
1-2
3-4
6-7
5-6
8-9
10-11
530
82
8.2
530
115
115
110V
17V
17V
110V
24V
24V
2650Ω
4.5Ω
4.5Ω
50Ω
2.65Ω
1Ω
1Ω
0.224Ø
0.224Ø
0.224Ø
0.63
0.63
0.63

FOR THE SETTINGS OF THE OSCILLOSCOPE UNDER TEST SEE CHAPTER 3.3.2.

FOR MEASURING THESE WAVE FORMS A PROBE 10:1 MUST BE USED



TABEL T101

COIL	S1	S1'	S1a	S1'b	S2	S3
CONNECTIONS	1-2	3-4	6-7	5-6	8-9	10-11
TURNS	530	82	82	530	115	115
R.M.S. VOLTAGE	110V	17V	17V	110V	24V	24V
R 20°C ± 10°C	29.5Ω	4.5Ω	4.5Ω	29.5Ω	1Ω	1Ω
ø	0.224	0.224	0.224	0.224	0.63	0.63

MAT311

Fig. 3.44. Circuit diagram of power supply, Z-amplifier and C.R.T. circuit

AMPL. / DIV. (S9)

SECTION I F

SECTION I R

SECTION II F

SECTION III R

INPUT A

AMPL./DIV. SWITCH (S9/S11)

BOTH FRONT AND REAR SECTIONS OF THE AMPL. DIV. SWITCHES ARE SEEN FROM THE FRONT SIDE.

ALL PUSHBUTTONS ARE DRAWN IN THE RELEASED POSITIONS.

AMPL./DIV. (S11)

INPUT B

AMPL./DIV. (S6)
SECTION III F
CLOSED IN POSITIONS
10mV, 5mV AND 2mV

AMPL./DIV. (S8)
SECTION III F
CLOSED IN POSITIONS
10mV, 5mV AND 2mV

MECHANICALLY INTERACTING

CHOP

ADD

ALT

TO R1653 AND R1686 OF THE ALTERNATE TIME BASE LOGIC

ALTERNATE PULSE FROM V1661 OF THE ALTERNATE TIME BASE LOGIC

CHANNEL A TRIGGER PICK OFF (SWITCH 21D)

CHANNEL A TRIGGER PICK OFF (SWITCH 22C)

CHANNEL B TRIGGER PICK OFF (SWITCH 21C)

CHANNEL B TRIGGER PICK OFF (SWITCH 22D)

POSITION

NORMAL / INVERT

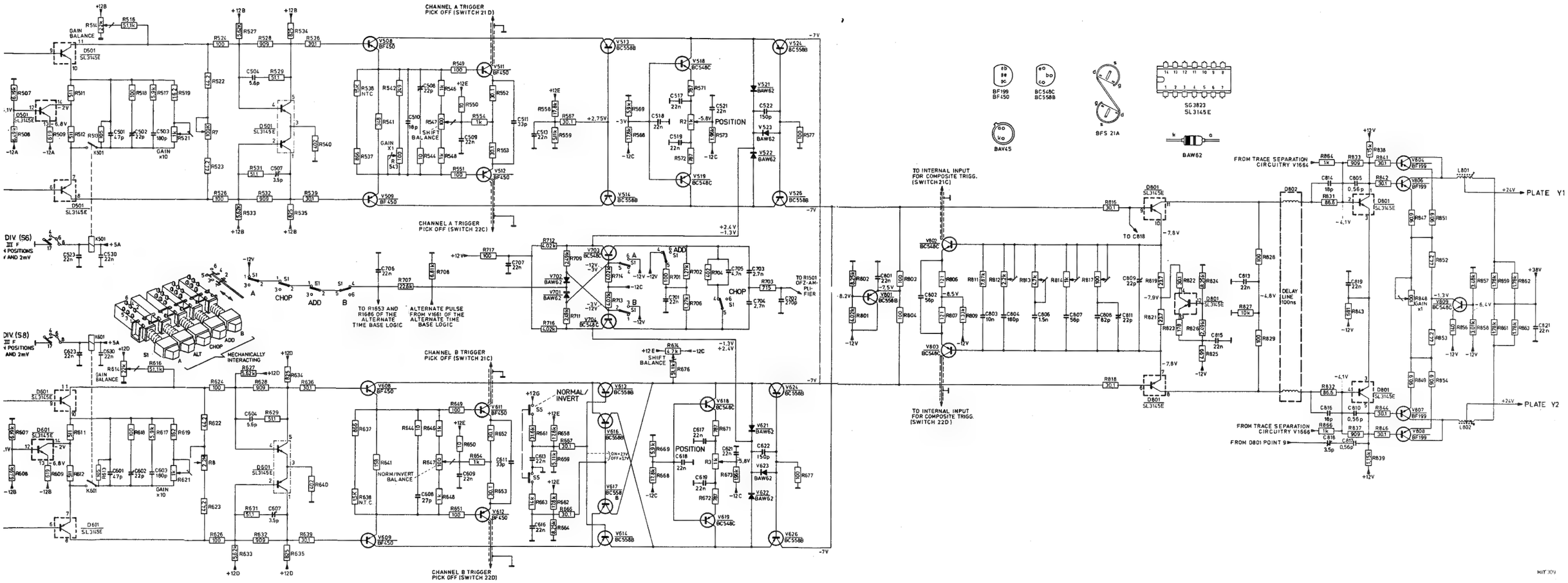
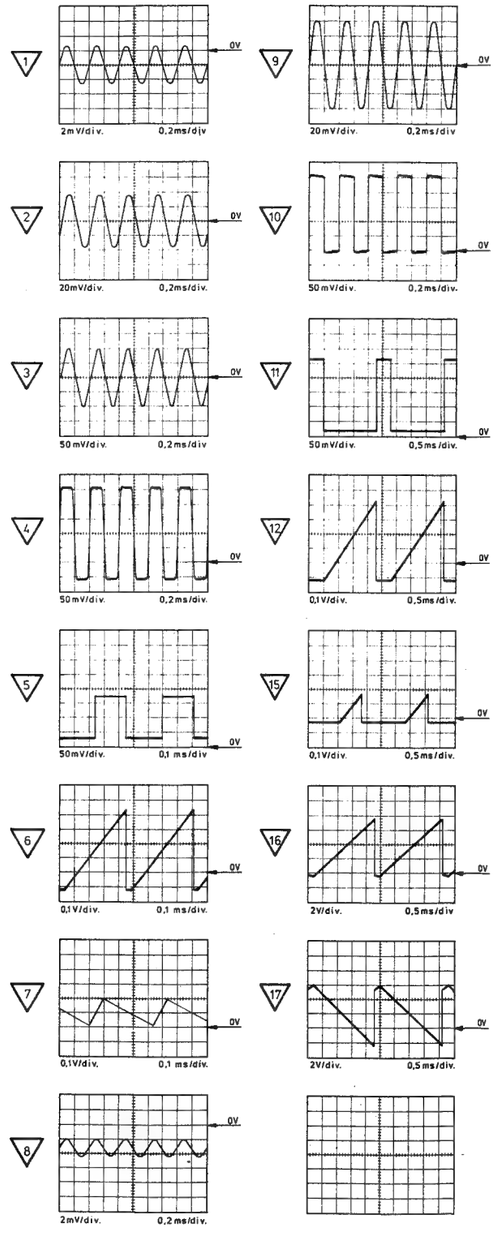
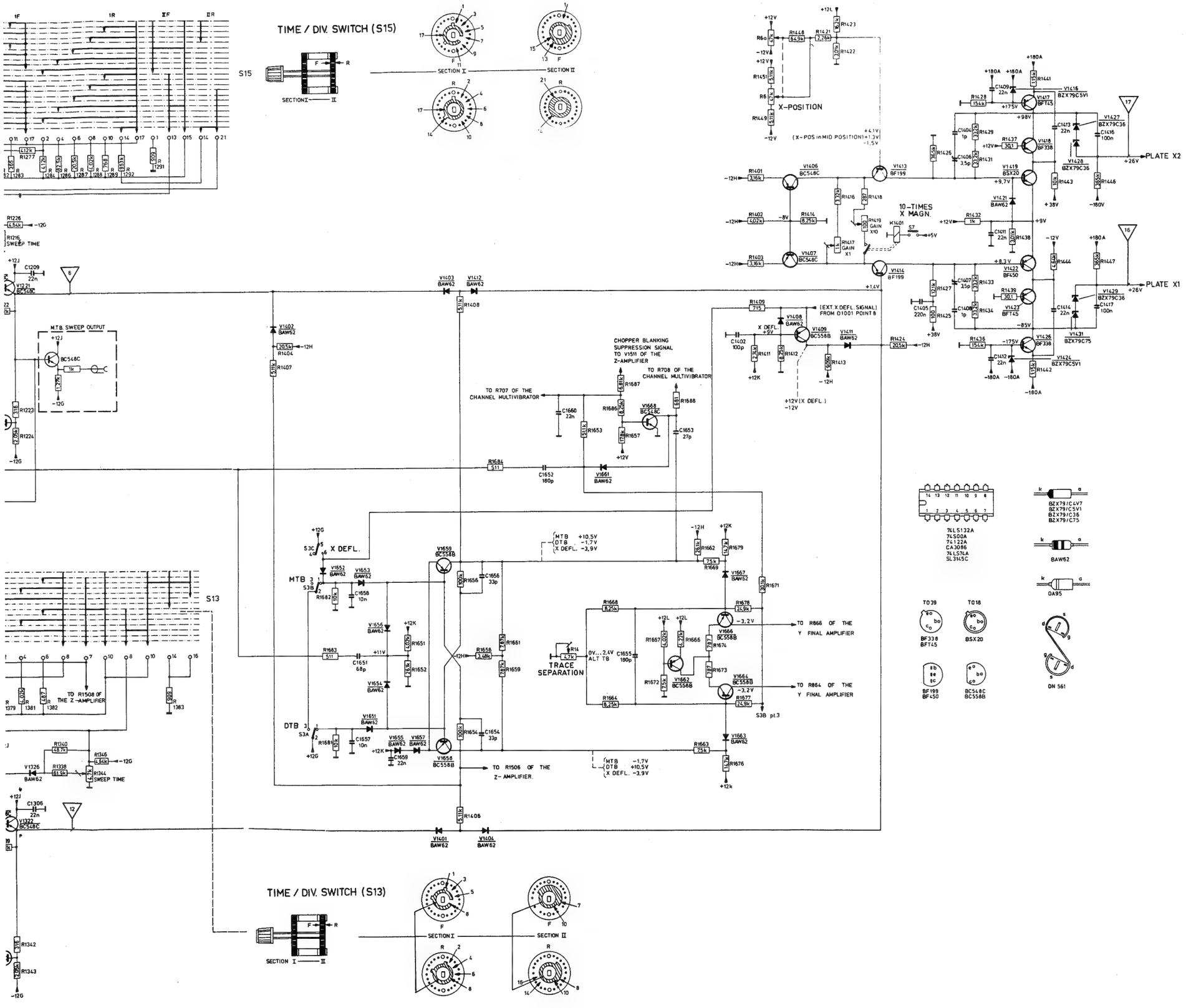


Fig. 3.45. Circuit diagram of the vertical amplifiers

FOR THE SETTINGS OF THE OSCILLOSCOPE UNDER TEST SEE CHAPTER 3.3.2.

FOR MEASURING THESE WAVE-FORMS A PROBE 10:1 MUST BE USED





MAT 310

Fig. 3.46. Circuit diagram of the main and delayed time-bases

TIME / DIV. SWITCH (S15)

S15

SECTION I — II

SECTION I

TIME / DIV. SWITCH (S13)

S13

SECTION I — II

SECTION I

MECHANICALLY INTERACTING

MECHANICALLY INTERACTING

MECHANICALLY INTERACTING

MAIN TIME-BASE UNBLANKING-SIGNAL TO DIODE V1502 OF THE Z-AMPLIFIER

DELAYED TIME-BASE UNBLANKING SIGNAL TO DIODE V1503 OF THE Z-AMPLIFIER

TO R CHANNEL

TO Z-

TD R1508 OF THE Z-AMPLIFIER

M.T.B. SWEEP OUTPUT

GATE OUT M.T.B.

GATE OUT D.T.B.

DELAY TIME

SWEEP TIME

TIME/DIV.

CAL

X DEFL.

MTB

DTB

EXTERNAL TRIGGER OR X-DEFLECTION INPUT

INTERNAL TRIGG. INPUT CHANNEL A (FROM COLL V502)

INTERNAL INPUT FOR COMPOSITE TRIGG (FROM COLL V601)

INTERNAL TRIGG INPUT CHANNEL B (FROM COLL V612)

INTERNAL INPUT FOR COMPOSITE TRIGG (FROM COLL V902)

INTERNAL TRIGG. INPUT CHANNEL A (FROM COLL V511)

INTERNAL TRIGG. INPUT CHANNEL B (FROM COLL V611)

EXTERNAL TRIGGER INPUT

TO R1022 OF LEVEL DETECT.

TO EMITTER OF V409 (EXT X-DEFL SIGNAL)

FROM TRANSFORMER T101 POINT 8 (FROM T101 POINT 11) 12 V p-p

TRIGGERSIGNAL (FROM D1001 POINT 11)

BOTH FRONT AND REAR SECTIONS OF THE PUSHBUTTONS ARE SEEN FROM THE FRONT SIDE.

ALL PUSHBUTTONS ARE DRAWN IN THE RELEASED POSITIONS.

DELAYED TIME-BASE UNBLANKING SIGNAL TO CRT CATHODE VIA THE Z-AMPLIFIER

GATE OUT D.T.B.

MECHANICALLY INTERACTING